

2004 Annual Report

Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 9



**Prepared for the U.S. Army Corps of Engineers – Northwest Division
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EXECUTIVE SUMMARY

The Nebraska Game and Parks Commission (NGPC) is participating with the U.S. Army Corps of Engineers in the Long Term Pallid Sturgeon Assessment. NGPC sampled the reach from the Platte River (River Mile (R.M.) 595.0) to the Kansas River (R.M. 367.5).

The sturgeon season started during late-October and continued until mid-November, when ice flows started. Sampling then continued in early-March, when ice flows subsided, and continued until 30 June. During the sturgeon season, a total of four hundred eighty-two samples were completed using gill nets, otter trawls, beam trawls, trammel nets and hoop nets. A total of 4,150 fish were sampled, including eight pallid sturgeon. Seven pallid sturgeon were collected while gill netting and one while trammel netting. Six of the eight are assumed wild because they had not been previously tagged and had no evidences of being previously tagged. Size ranged from 390 to 1,069 mm for the wild pallid sturgeon compared to 248 to 562 for hatchery reared pallid sturgeon.

The fish community season started 1 July and continued until late-October when water temperature fell below 12.7°C. A total of five hundred thirty-three samples were completed using otter trawls, beams trawls, trammel nets, hoop nets, mini-fyke nets and a seine. A total of 6,002 fish were sampled, including three pallid sturgeon. Two pallid sturgeon were collected using an otter trawl and one using a trammel net. All three pallid sturgeon had been previously tagged with a PIT and/or elastomere tag. Size ranged during this season was 111 to 409 mm.

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INTRODUCTION

Being native to the Missouri and Mississippi River systems, the pallid sturgeon has evolved with and adapted to large river conditions. Due to population declines, pallid sturgeon (*Scaphirynchus albus*) were federally listed as endangered in 1990. Modification of the pallid sturgeon's habitat by human activities has blocked fish movement, destroyed or altered spawning areas, reduced food sources or ability to obtain food, altered water temperature, reduced turbidity, and changed hydrograph (USFWS 1993). In response to obvious declines in population and lack of recruitment, the United States Fish and Wildlife Service developed the Biological Opinion on the Operation of the Missouri River Main System Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System (Bi-Op) in 2000. This report made recommendations to the U.S. Army Corp of Engineers (USACE) to modify flows of the Missouri River to a more natural regime, to increase pallid sturgeon propagation and augmentation efforts, and to assist and provide funding for a basin-wide pallid sturgeon assessment. In response to the Bi-Op, the USACE formed the Pallid Sturgeon Population Assessment Team with representatives from federal and state agencies and universities. The team developed standard operating procedures (SOP) for long-term pallid sturgeon and associated fish community assessment for the Missouri River. This included creating standard habitat definitions, selecting and describing standard sampling gears thought to be suitable for use in the Missouri River, creating sampling protocols for sampling fish and habitat parameters, developing standard data sheets and reporting procedures.

SAMPLING SEASONS

The 2004 sampling season extended from the fall of 2003 through the fall of 2004 and was divided into two seasons: the sturgeon season and the fish community season. The reason for a split in seasons was that during the sturgeon season, the capture of sturgeon was more efficient due to increased sturgeon movement and the ability to use gill nets, an effective gear for sampling sturgeon when water temperatures permit. The fish community sampling season provided the best time to identify natural reproduction of pallid sturgeon and other native target species. Because sturgeon were less active and gill nets could not be used because of temperature restrictions, efforts were focused on sampling the associated fish community, including chubs and minnows, which were abundant during this time. Having only two sampling seasons in 2004 was a change in the SOP from past years when winter gill netting was considered a separate season. For the 2004 sampling season, the winter gill netting season was incorporated into the sturgeon sampling season. Therefore, the sturgeon season was defined as the period when water temperatures fell below 12.7° C (55° F), until 30 June. While water temperatures were below 12.7° C, experimental gill nets were used, and above this temperature, four additional gears were fished: trammel nets, hoop nets, otter trawls and beam trawls. Sampling was on the bend level, eight bends were randomly selected and two bends non-randomly selected. The fish community season began 1 July and continued until water temperatures dropped below 12.7° C. Six gear types were used during the fish community season: trammel nets, hoop nets, otter trawls, beam trawls, seines and mini-fyke nets. Sampling was on the bend level, eight bends were randomly selected and two bends were non-randomly selected.

During the fish community season, native species other than the pallid sturgeon were targeted. The Pallid Sturgeon Assessment Team assembled a list of nine target species that represent the native warm water benthic fish community (Appendix A). These species could serve as indicators of changes for this community. The nine target species are: shovelnose sturgeon *Scaphirhynchus platorynchus*, blue sucker *Cycleptus elongatus*, sauger *Stizostedion canadense*, bigmouth buffalo *Ictiobus cyprinellus*, sturgeon chub *Macrhybopsis gelida*, sicklefin chub *Macrhybopsis meeki*, speckled chub *Macrhybopsis aestivalis*, plains minnow *Hybognathus placitus*, and sand shiner *Notropis stramineus*.

OBJECTIVES

In early 2005, the Pallid Sturgeon Assessment Team reassessed its goals and revised its objectives. The revised objectives along with the measurable hypotheses that came from the discussion are as follows:

Objective 1. Document annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River System.

- 1.1. H₀: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.
H_a: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.
- 1.2 H₀: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages remain constant over time
H_a: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages increase or decrease over time.
- 1.3 H₀: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.
H_a: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.
- 1.4 H₀: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages remains constant over time
H_a: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages increase or decrease over time.

Objective 2. Document annual results and long-term trends of habitat usage of wild pallid sturgeon and hatchery stocked pallid sturgeon by season by life stage.

- 2.1 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages annually.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages annually.
- 2.2 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages over the long term.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages over the long term.

Objective 3. Document the population structure and dynamics of pallid sturgeon in the Missouri River system.

- 3.1 H₀: The population structure of stocked and wild pallid sturgeon remains constant over time.
H_a: The population structure of stocked and wild pallid sturgeon changes over time.
- 3.2 H₀: The population dynamics of stocked and wild pallid sturgeon remain constant over time.
H_a: The population dynamics of stocked and wild pallid sturgeon change over time.

Objective 4. Document annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River System.

- 4.1 H₀: Annual trends in native target species abundance are stable throughout the year.
H_a: Annual trends in native target species abundance increase or decrease throughout the year.
- 4.2 H₀: Annual trends in native target species geographic distribution remains stable throughout the year.
H_a: Annual trends in native target species geographic distribution increases or decreases throughout the year.
- 4.3 H₀: Long-term trends in native target species population abundance are stable over time.
H_a: Long-term trends in native target species population abundance increases or decreases over time.
- 4.4 H₀: Long-term trends in the native target species geographic distribution remain constant over time.
H_a: Long-term trends in the native target species geographic distribution increases or decreases over time.

Objective 5. Document annual results and long-term trends of habitat usage of the native target species by season and life stage.

- 5.1 H₀: Native target species use the same habitat during all life stages annually.
H_a: Native target species do not use the same habitat during all life stages annually.
- 5.2 H₀: Native target species use the same habitat during all life stages over the long term.
H_a: Native target species do not use the same habitat during all life stages over the long term.

Objective 6. Document annual results and long-term trends of all non-target species population abundance and geographic distribution throughout the Missouri River system, where sample size is greater than fifty individuals.

- 6.1 H₀: Annual trends in non-target species abundance are stable throughout the year.
H_a: Annual trends in non-target species abundance are increasing or decreasing throughout the year.
- 6.2 H₀: Annual trends in non-target species geographic distribution remains stable throughout the year.
H_a: Annual trends in non-target species geographic distribution increases or decreases throughout the year.
- 6.3 H₀: Long-term trends in non-target species population abundance are stable over time.
H_a: Long-term trends in non-target species population abundance increases or decreases over time.
- 6.4 H₀: Long-term trends in the non-target species geographic distribution remain constant over time.
H_a: Long term trends in the non-target species geographic distribution increases or decreases over time.

STUDY AREA

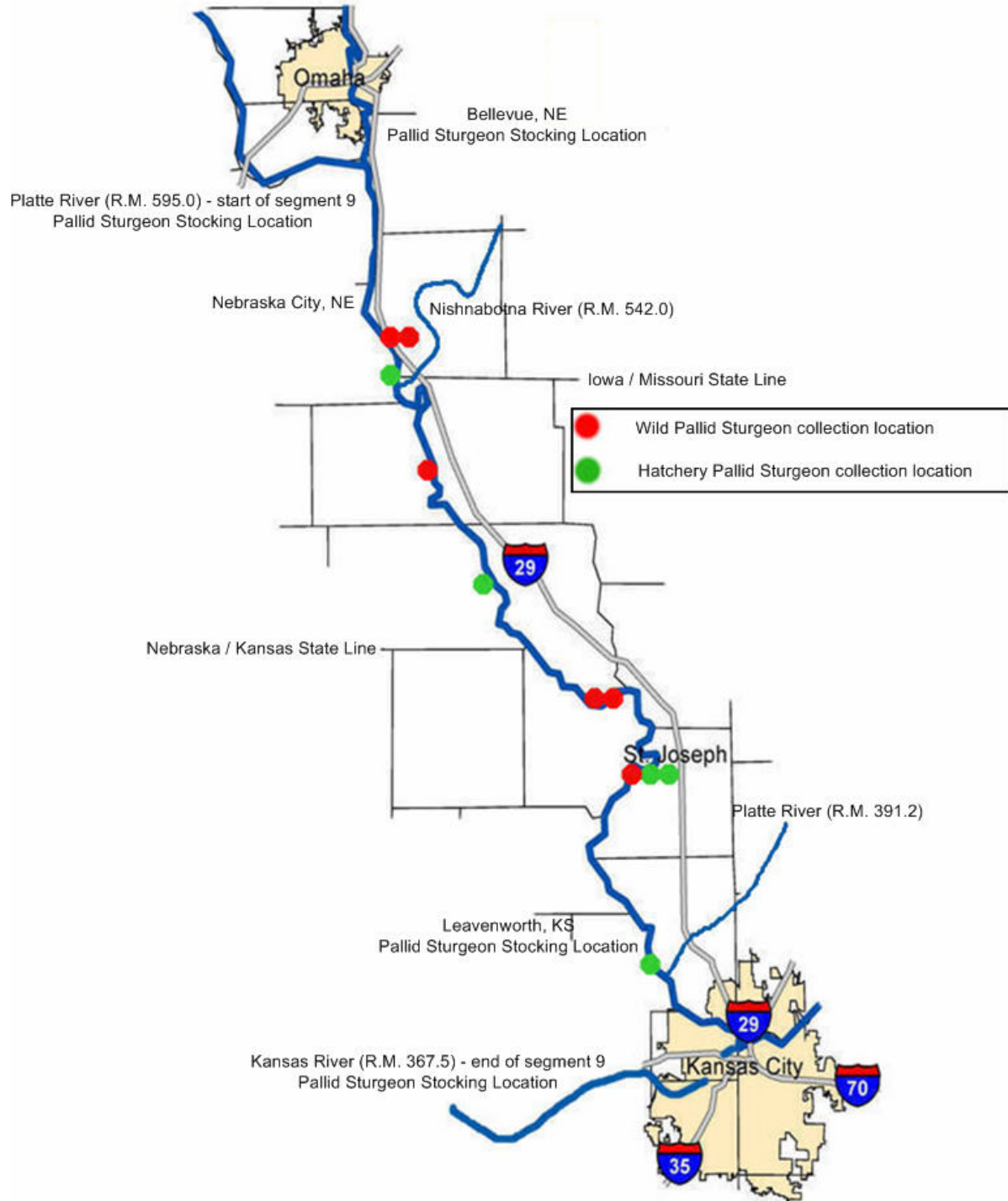
This project area includes the Missouri River from Fort Peck Dam (R.M. 1771.5) to the confluence of the Missouri and Mississippi Rivers (R.M. 0) and the lower reach of the Kansas River from the Johnson County Weir (R.M. 15.4) to the confluence with the Missouri River (R.M. 0.0). The Biological Opinion divided the Missouri River into river and reservoir reaches and categorized these areas as high, moderate or low priority management areas. The areas

which were given high priority designation by the Bi-Op for the pallid sturgeon include Segment Area 2 (Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota), Area 8 (Fort Randall Dam, South Dakota to the Mouth of the Niobrara River, Nebraska), and Areas 10 through 15 (Gavins Point Dam, Nebraska/South Dakota to the mouth of the Missouri River at St. Louis, MO).

The Pallid Sturgeon Population Assessment Team identified 14 river segments based on changes in physical attributes such as degrading or aggrading stream bed, flow fluctuation, natural hydrograph, stream gradient, geology, water temperature, turbidity, substrate, discrete habitat changes (tributary or tributary influence) and modifications (presence of restoration projects) (Drobish, editor 2005). There are areas sampled that were not designated as high priority area in the Bi-Op including; the Kansas River from Johnson County Weir to the mouth and Bi-Op Segment Area 9 (Niobrara River, Nebraska to the headwaters of Lewis and Clark Lake Nebraska/South Dakota). Bi-Op Segment Area 9 was sampled because telemetry studies have shown juvenile pallid sturgeon using this transitional areas.

The Nebraska Game and Parks Commission sampled Assessment Team Segment 9 from the confluence of the Platte and Missouri Rivers at Plattsmouth, Nebraska, downstream to the mouth of the Kansas River at Kansas City, Missouri (Figure 1). This 227.5 mile long segment consists of 80 named bends.

Figure 1. Map of segment 9 of the Missouri River with major tributaries, common landmarks, and stocking locations for pallid sturgeon. Segment 9 encompasses the Missouri River from the Platte River to the Kansas River.



METHODS

Gear and methods were developed by the Pallid Sturgeon Assessment Team and described in Long-term Pallid Sturgeon and Associated Fish Community Assessment for the Missouri River and Standardized Guidelines for Sampling and Data Collection, (Draft), (Drobish, editor 2005). Collection methods, including the handling of pallid sturgeon, conformed with methods described in Biological Procedures and Protocol for Collecting, Tagging, Sampling, Holding, Culture, Transporting, and Data Recording for Researchers and Managers Handling Pallid Sturgeon (Krentz 2001). Morphometric measurements were recorded when a pallid sturgeon was sampled, along with pictures, habitat parameters, and all tagging information. If the pallid sturgeon had not been previously PIT tagged, a PIT tag was placed in accordance with the protocols. Other target species were measured to the nearest millimeter and weighed to the nearest gram. All non-target species collected were measured to nearest millimeter and released. An exception to this was during the community sampling season, when seine and mini-fyke net samples were preserved in 10% formalin and brought back to the lab for identification. Seine and mini-fyke net samples were identified to species, stored in 70% alcohol and labeled by species by sample. Habitat samples were collected at the site of every pallid sturgeon capture, and were collected at 25% of the remaining sampling sites by mesohabitat. The predetermined parameters for habitat sampling were GPS coordinates (latitude and longitude in decimal degrees), water depth (m), water velocity ((mps) at bottom, 0.2, and 0.8 of water column), water temperature (°C), turbidity (NTU), and sediment profile (based on percent of gravel, sand and silt).

HABITAT CLASSIFICATION

The Pallid Sturgeon Assessment Team developed a standard set of habitat classifications for the Missouri River (Appendix B). Each river bend contains three continuous macrohabitats, main channel outside bend (OSB), main channel inside bend (ISB), and main channel cross over (CHXO). Additional discrete macrohabitats have been identified that are not present in every bend. These include: large tributary mouth (TRML), small tributary mouth (TRMS), tributary confluence (CONF), large secondary channel-connected (SCCL), small secondary channel-connected (SCCS), and non-connected secondary channel (SCN). Mesohabitats have been established and defined to further classify areas within macrohabitats. Mesohabitat classifications include bars (BARS), pools (POOL), channel borders (CHNB), thalweg (TLWG) and island tips (ITIP). Bars are sandbars or shallow bankline habitat at the area of terrestrial/aquatic interface, where water depth is less than 1.2 m deep. Pools are areas immediately downstream from sandbars, dikes, snag-piles or other obstructions that have formed a scour hole greater than 1.2 m deep. Channel borders lie along a bankline or sandbar area between the thalweg and the 1.2 m depth interval. Thalweg is the main channel between the channel borders and is the area of maximum depth. Island tips are the areas immediately downstream of a bar or island where two channels converge and water depth is greater than 1.2 m. Microhabitats are used to further describe mesohabitats including unique structural modifications.

GEAR

Gill Net

The standard gill net was a four panel experimental gill net 30.5 m (100 ft.) long with a height of 2.4 m (8 ft.). The standard gill net had four 7.6 m (25 ft.) panels consisting of 38.1 mm (1.5") (Panel 1), 50.8 mm (2.0") (Panel 2), 76.2 mm (3.0") (Panel 3), and 101.6 mm (4.0") (Panel 4) multifilament bar mesh. Twine size was #104 for the 38.1 mm and 50.8 mm panels and #139 for the 76.2 mm and 101.6 mm panels. The float line was a braided poly-foam core of 13 mm (1/2") diameter and the lead line was 7.1 mm (9/32") (22.7 kg./600 ft.). A double length gill net (61 m or 200 ft.) could be used when needed to sample a particular location and consisted of two standard gill nets attached together but counted as twice the effort. Panel numbering continued for 61 m nets, so the second 38.1 mm mesh was panel 5, the second 50.8 mm mesh was panel 6, the second 76.3 mm mesh was panel 7 and the second 101.6 mm mesh was panel 8. The lead panel (38.1 mm (Panel 1) or 101.6 mm mesh (Panel 4 or 8)) was selected randomly and recorded. Gill net samples were overnight sets with a maximum set time of 24 hours.

Otter Trawl

The standard otter trawl had a width of 4.9 m (16 ft.), height of 0.9 m (3 ft.), and length of 7.6 m (25 ft.). The trawl had an inner mesh (6.35 mm (1/4") bar, #18 polyethylene twine) and an outer mesh (38.1 mm (1.5") bar, #9 polyethylene twine), with a cod-end opening of 406.4 mm (16"). The inner mesh had a 50.8 mm (2") sleeve sewn along the top section for the insertion of a hoop to keep the net open, allowing fish to reach the cod end of the net. Trawl doors made from 19.1 mm (3/4") marine plywood, measuring 762 mm (30") by 381 mm (15"), were used to keep the trawl deployed on the river bottom. A 7.9 m (26 ft.) tickler chain (3.2 mm (0.125") galvanized) was attached to the back corner of the trawl doors and ran approximately three feet

in front of the footrope. The tickler chain aided in dragging the river bed and provided some additional protection for the lower mouth of the otter trawl. Otter trawls were fished downstream with length of trawl dependent upon the size of the macrohabitat and mesohabitat being sampled. Otter trawl samples covered a minimum of 75 m (246 ft.) and a maximum of 300 m (984 ft.).

Beam Trawl

The standard beam trawl was 2.0 m (6.4 ft.) wide, 0.5 m (1.6 ft.) high and 457.2 mm (18") deep. The trawl was composed of an outer mesh of #15 twisted nylon twine bar netting with a mesh size of 15.9 mm (5/8"), and an inner mesh of 3.2 mm (1/8") delta netting. The net was attached to a steel frame composed of two triangular skids connected by a 2 m (6.4 ft.) piece of square tubing. A footrope chain was attached to the lower corners of the beam trawl frame to ensure the net remained on the river bottom. Beam trawl samples had no minimum distance but had a maximum of 300 m (984 ft.).

Trammel Net

The standard trammel net had a length of 38.1m (125 ft.), with an inner mesh 2.4 m (8 ft.) deep and two outer walls 1.8 m (6 ft.) deep. The inner mesh was composed of #139 multifilament twine with a bar mesh size of 25.4 mm (1.0"). The outer walls were #9 multifilament twine with a bar mesh size of 203.2 mm (8.0"). The float line was a 12.7 mm (1/2") foam core and the lead line was 22.7 kg (50 lb.). Trammel nets were drifted a maximum of 300 m and a minimum of 75 m.

Hoop Net

The standard hoop nets were made of #15 twine with 38.1 mm (1.5") bar mesh and were supported by seven tapered fiberglass hoops approximately 1.2 m (4 ft.) in diameter. The net had two inner throats on the 2nd and 4th hoops. Hoop net hooks were used to secure the net to

the river bottom; a 7.6 m (25 ft.) lead rope was tied to the hoop net hook and to the back end of the hoop net. A rope with a float was attached to the mouth of the hoop net for retrieval. Hoop net samples were overnight sets with a maximum set time of 24 hours.

Seine

The standard seine was 9.1 m (30 ft.) long by 1.8 m (6 ft.) high with a bag that measured 1.8 m x 1.8 m x 1.8 m. The seine had 6.4 mm (1/4") ace mesh with a 29.5 kg (65 lb.) lead core line. Seines were pulled upstream in a quarter arc, half arc, or rectangular fashion. The area sample (length and width) was measured to the nearest tenth of a meter using a 100 m (328 ft.) field tape.

Mini-Fyke Net

The standard mini-fyke net had two rectangular frames (1.2 m (4.0 ft.) by 0.6 m (2.0 ft.)) and two hoops (0.6 m (2.0 ft.)) made of oil tempered spring steel. A 4.5 m (15 ft.) by 0.6 m (2.0 ft.) lead was connected to the second rectangular frame. The mini-fyke net had 3 mm (1/8") ace mesh with a 29.5 kg (65lb.) lead core line. Mini-fyke net samples were overnight sets with a maximum set time of 24 hours.

Catch per Unit Effort

All fish collections are reported as catch per unit effort (CPUE) with associated standard error. CPUE for gill nets is reported as the number of fish per 100 feet gill net-night. CPUE for otter trawls and beam trawls are reported as number of fish per 100 linear meters trawled. CPUE for trammel nets is reported as number of fish per 100 meters drifted. CPUE for hoop nets and mini-fyke nets are reported as number of fish per net-night. CPUE for seining is reported as number of fish per 100 meters squared seined. CPUE is calculated for each subsample instead of

overall catch per overall effort in order to get a measure of variance. These individual CPUEs are then averaged to get a total CPUE for an individual gear, bend or segment.

Character Index

Pallid sturgeon, shovelnose sturgeon and hybrids can be distinguished using meristic and morphometric characteristics. Sheehan et al. (1997) developed the character index (CI) using two meristics (dorsal and anal fin ray counts) and five morphometric ratios. This equation categorized *Scaphirhynchus* specimens into three categories. Character index values for pallid sturgeon range from -1.48 to -0.09, hybrid sturgeon from -0.45 to 0.51 and shovelnose sturgeon from 0.37 to 1.33.

Relative Condition

The relative condition of recaptured hatchery reared pallid sturgeon was calculated using $Kn = (W / W')$, where W is weight of the individual and W' is the length-specific mean weight predicted by the weight-length equation calculated for that population. Keenlyne and Evanson (1993) provided a weight-length regression [$\log_{10} W = -6.378 + 3.357 \log_{10} L$ ($r^2 = 0.9740$)] for pallid sturgeon throughout its range which was used to calculate a relative condition factor.

Relative Stock Densities

A length frequency index measures changes in a population structure. Length categories were based on the percentage of the largest known pallid sturgeon are as followed (Gablehouse 1984): sub-stock fork length < 330 mm (20%), stock fork length = 330 – 629 mm (20 – 36%), quality fork length = 630 – 839 mm (36 - 45%), preferred fork length = 840 – 1039 mm (45 – 59%), memorable fork length = 1040 – 1269 mm (59 – 74%) and trophy fork length > 1270 mm (> 74%). Length categories based on the percentage of the largest known shovelnose sturgeon are as follows: sub-stock fork length < 250 mm (20%), stock fork length = 250 – 379 mm (20 –

36%), quality fork length = 380 – 509 mm (36 - 45%), preferred fork length = 510 – 639 mm (45 – 59%), memorable fork length = 640 – 809 mm (59 – 74%) and trophy fork length > 810 mm (> 74%). Proportional Stock Density (PSD) is proportion of fish of quality size in a stock. Relative Stock Density (RSD) is the proportion of fish of a size group in a stock.

Effort

The 100' and 200' standard gill nets have been used since this project started in March of 2003 and were only used during the sturgeon season due to temperature restrictions (Appendix C). Gill nets were set on the CHNB and POOL mesohabitats within the OSB, ISB, CHXO, SCCL, TRML and CONF macrohabitats (Table 1 and 2). A total of 289 net/nights of effort were expended in segment 9 with gill nets during 2004.

The standard 16' otter trawl has been used since this project started in March of 2003 and was used during the sturgeon season and the fish community season. Otter trawls were used to sample the CHNB mesohabitat within the OSB, ISB, CHXO, SCCL, SCCS, TRML and CONF macrohabitats. A total of 181 otter trawl samples were collected in segment 9 during 2004 covering 24,483 meters. Effort for the sturgeon season was 114.4 meters trawled compared to 130.5 meters trawled for the fish community season.

The standard beam trawl has been used since this project started in March of 2003. Beam trawls were used during the sturgeon season and the fish community season. They were used to sample the POOL mesohabitat within the OSB, ISB, CHXO, SCCL, and CONF macrohabitats. A total of 158 beam trawl samples were collected in segment 9 during 2004 covering over 10,000 meters. Effort for the sturgeon season and fish community season was 50.2 and 50.9 meters trawled, respectively. Due to lack of fish collected, it has been dropped as a standard gear for the 2005 sampling season.

The standard trammel nets have been used since this project started in March of 2003 and were used during the sturgeon season and the fish community season. Trammel nets were used to sample the CHNB mesohabitat within the ISB, CHXO, SCCL, and CONF macrohabitats. A total of 177 trammel net drifts were conducted in segment 9 during 2004 covering 18,670 meters. Effort for the sturgeon season was 88.4 meters drifted compared to 98.3 meters drifted for the fish community season.

The standard hoop net has been used since this project started in March of 2003. Hoop nets were used during the sturgeon season and the fish community season. They were used to sample the CHNB mesohabitat within the OSB, ISB, CHXO, SCCL, SCCS, TRML and CONF macrohabitats. A total of 180 hoop net sets were made in segment 9 during 2004. Effort for the sturgeon season and fish community season was 87 net/nights and 93 net/nights, respectively. Due to its lack of pallid sturgeon collected, it has been dropped as a standard gear for the 2005 sampling season.

The standard bag seine has been used since this project started in March of 2003 and was used during the fish community season. Seines were used to sample the BARS mesohabitat within the OSB, ISB, CHXO, SCCL, TRML and CONF macrohabitats. A total of 80 seine samples were collected in segment 9 during 2004 resulting in an effort of 92.7 squared meters seined.

The standard mini-fyke net has been used since this project started in March of 2003 and was used during the fish community season. Mini-fyke nets were used to sample the BARS mesohabitat within the OSB, ISB, CHXO, SCCL, TRML and CONF macrohabitats. A total of 79 mini-fyke sets were made in segment 9 during 2004 resulting in an effort of 79 net-nights.

Table 1. Number of bends sampled, mean effort per bend (as deployments of each gear type), and total gear deployments by macrohabitat for segment 9 in the Missouri River during sturgeon season and fish community season in 2004.

Gear	Number of Bends	Mean Effort/ Bend	Macrohabitat												Total
			OSB	ISB	CHXO	SCCL	SCCS	SCN	TRML	TRMS	CONF	BRAD	DEND	DRNG	
Sturgeon Season															
Gill Net	14	20.6	42.0	176.0	42.0	11.0		N-E	2.0		16.0	N-E	N-E	N-E	289.0
Trammel Net	10	8.9		58.8	20.7	2.9		N-E			6.0	N-E	N-E	N-E	88.4
Beam Trawl	10	5.0	4.8	21.5	21.1	1.8		N-E			1.0	N-E	N-E	N-E	50.2
Otter Trawl	10	11.4	3.0	64.7	26.9	3.9	2.4	N-E	7.8		5.8	N-E	N-E	N-E	114.4
Hoop Net	10	8.7	5.0	54.0	19.0	4.0	1.0	N-E	2.0		2.0	N-E	N-E	N-E	87.0
Fish Community Season															
Bag Seine	10	9.3	8.8	51.6	22.3	1.9		N-E	4.8		3.3	N-E	N-E	N-E	92.7
Mini-Fyke	10	7.9	11.0	41.0	22.0	2.0		N-E	2.0		1.0	N-E	N-E	N-E	79.0
Trammel Net	10	9.8		67.3	20.1	6.3		N-E			4.8	N-E	N-E	N-E	98.3
Beam Trawl	10	5.1	8.2	18.5	19.0	1.6		N-E			3.6	N-E	N-E	N-E	50.9
Otter Trawl	10	13.1	2.7	81.6	27.0	7.2		N-E	6.0		6.0	N-E	N-E	N-E	130.5
Hoop Net	10	9.3		61.0	22.0	6.0		N-E	2.0		2.0	N-E	N-E	N-E	93.0

N-E: non-existent macrohabitat in Segment 9.

Table 2. Number of bends sampled, mean effort per bend (as deployments of each gear type), and total gear deployments by mesohabitat for segment 9 in the Missouri River during sturgeon season and fish community season in 2004.

Gear	Number of Bends	Mean Effort/Bend	Mesohabitat					Total
			BARS	POOL	CHNB	TLWG	DTWT	
Sturgeon Season								
Gill Net	14	20.6		193.0	96.0		N-E	289.0
Trammel Net	10	8.9			88.4		N-E	88.4
Beam Trawl	10	5.0		50.2			N-E	50.2
Otter Trawl	10	11.4			114.4		N-E	114.4
Hoop Net	10	8.7			87.0		N-E	87.0
Fish Community Season								
Bag Seine	10	9.3	92.7				N-E	92.7
Mini-Fyke	10	7.9	79.0				N-E	79.0
Trammel Net	10	9.8			98.3		N-E	98.3
Beam Trawl	10	5.1		50.9			N-E	50.9
Otter Trawl	10	13.1			130.5		N-E	130.5
Hoop Net	10	9.3			93.0		N-E	93.0

N-E: non-existent mesohabitat in Segment 9.

RESULTS – SEGMENT 9

Pallid sturgeon

Objective 1. Document annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River System.

During the 2004 sampling year, Nebraska Game and Parks Commission sampled eleven pallid sturgeon. Seven were sampled while winter gill netting, with two sampled pre-winter (29 October through 19 November 2003) and the remaining sampled post winter (8 March through 14 April 2004). The first was sampled on 11 November in Upper Hamburg Chute (RM 554.5). It had a fork length of 1,027 mm and weighed 3,990 grams. The gill net was set in a secondary connected channel large macrohabitat off the tip of a wing dike in a pool mesohabitat. The pallid sturgeon was sampled in panel 4 (4.0" mesh). The sampling location had a depth of 5.5 meters and a bottom velocity of 0.18 mps. It had not been previously tagged and is assumed to be a wild fish until the results of the genetic analysis are obtained.

The second pallid sturgeon was sampled on 11 November on Lower Cottier Bend (RM 506.5). It had a fork length of 562 mm and weighed 428 grams. The net was set on the outside bend macrohabitat in a revetment scallop pool mesohabitat. The pallid sturgeon was sampled in panel 5 (1.5" mesh). The sampling location had a depth of 4.2 meters and bottom velocity was not measured due to windy conditions. It had been previously PIT tagged and was stocked at Bellevue, NE (RM 601) on 1 November 2002. It had a fork length of 488 mm and a weight of 406 grams at stocking.

The third pallid sturgeon was sampled on 10 March on Wolf Creek Bend (RM 480.0). It had a fork length of 804 mm and weighed 1,740 grams. The net was set on the channel cross-over macrohabitat in a wing dike field channel border mesohabitat. The pallid sturgeon was

sampled in panel 2 (2.0" mesh). The sampling location had a depth of 1.6 meters and bottom velocity 0.12 mps. It had not been previously tagged and is assumed to be a wild fish until the results of the genetic analysis are obtained.

The fourth pallid sturgeon was sampled on 10 March on Wolf Creek Bend (RM 478.7). It had a fork length of 1,013 mm and weighed 4,236 grams. The net was set on the inside bend macrohabitat off the tip of a wing dike in a pool mesohabitat. The pallid sturgeon was sampled in panel 4 (4.0" mesh). The sampling location had a depth of 5.4 meters and bottom velocity 0.00 mps. It had not been previously tagged and is assumed to be a wild fish until the results of the genetic analysis are obtained.

The fifth pallid sturgeon was sampled on 22 March on St. Joseph Bend (RM 445.1). It had a fork length of 945 mm and weighed 3,414 grams. The net was set on the inside bend macrohabitat off the tip of a wing dike in a pool mesohabitat. The pallid sturgeon was sampled in panel 7 (3.0" mesh). The sampling location had a depth of 2.9 meters and bottom velocity of 0.12 mps. It had not been previously tagged and is assumed to be a wild fish until the results of the genetic analysis are obtained.

The sixth pallid sturgeon was sampled on 6 April on Upper Hamburg Bend (RM 554.6). It had a fork length of 1,069 mm and weighed 4,722 grams. The net was set on the inside bend macrohabitat off the tip of a chevron dike in a pool mesohabitat. The pallid sturgeon was sampled in panel 6 (2.0" mesh). The sampling location had a depth of 1.7 meters and bottom velocity of 0.59 mps. It had not been previously tagged and is assumed to be a wild fish until the results of the genetic analysis are obtained.

The seventh pallid sturgeon was sampled on 14 April on Lower Kansas Bend (RM 543.7). It had a fork length of 390 mm and weighed 180 grams. The net was set on the inside

bend macrohabitat off the tip of a chevron dike in a pool mesohabitat. The pallid sturgeon was sampled in panel 5 (1.5" mesh). The sampling location had a depth of 2.5 meters and bottom velocity of 0.08 mps. It had not been previously tagged and had no evidence of a PIT tag scar and is assumed to be a wild fish until the results of the genetic analysis are obtained.

One pallid sturgeon was collected during the sturgeon season on the 29 June while trammel netting St. Joseph Bend (RM 448.5). It had a fork length of 248 mm and weighed 32 grams. The net was drifted in the channel cross-over macrohabitat inside of a wing dike field on the channel border mesohabitat. The sampling location had a depth of 3.0 meters and bottom velocity of 0.32 mps. It had been previously elastome tagged and was stocked at Boonville, MO (RM 195.1) on 2 December 2003. The stocking fork length and weight were not recorded prior to stocking.

Three pallid sturgeon were sampled during the fish community season. The first was sampled while trammel netting St. Joseph Bend (RM 447.7) on 20 July. It had a fork length of 409 mm and weighed 194 grams. The net was drifted on the inside bend macrohabitat inside of a wing dike field on the channel border mesohabitat. The sampling location had a depth of 2.0 meters and bottom velocity of 0.44 mps. It had been previously PIT tagged and was stocked at Verdel, NE (RM 851.5) on 21 April 2002. The stocking fork length was 210 mm and a weight was not recorded.

The next pallid sturgeon was collected while otter trawling Delaware Bend (RM 391.7) on 4 October. It had a fork length of 310 mm and weighed 56 grams. The trawl sample was collected on an inside bend macrohabitat inside of a wing dike field on the channel border mesohabitat. The sampling location had a depth of 2.5 m and bottom velocity of 0.38 mps. It

had been previously PIT and elastome tagged and was stocked at Leavenworth, KS (RM 397.6) on 30 July 2004. The stocking fork length was 258 mm with a weight of 50 grams.

The final pallid sturgeon collected during the 2004 sampling year was sampled while otter trawling Lower Hamburg Bend (RM 551.5) on 12 October. It had a fork length of 111 mm. Weight was not recorded due to the small size. The trawl sample was collected on an inside bend macrohabitat inside of an overflow dike field on the channel border mesohabitat. That sampling location had a depth of 2.2 meters and bottom velocity of 0.54 mps. It had been previously elastome tagged and was stocked at Bellvue, NE (601.0) or Boonville, MO (RM 195.1) on 10 September 2004. The stocking fork length was 86 mm with a weighed 2 grams.

CPUE for hatchery reared pallid sturgeon during the sturgeon gill net season remained similar (< 0.01 fish per net-night in 2003 compared to < 0.01 fish per net-night in 2004), while the CPUE for wild pallid sturgeon increased from < 0.01 fish per net-night in 2003 to 0.02 fish per net-night 2004 (Figure 2). CPUE for trammel netting during the sturgeon season increased from zero in 2003 to 0.02 fish per 100 m drifted in 2004. CPUE for otter trawling during the sturgeon season decreased from < 0.01 fish per 100 m trawled in 2003 to zero in 2004.

In 2003, no pallid sturgeon were collected during the fish community season (Figure 3). In 2004, one pallid sturgeon was collected while trammel netting resulting in a CPUE of < 0.01 fish per 100 m drifted and two pallid sturgeon were collected while otter trawling resulting in a CPUE of 0.01 fish per 100 m trawled.

A total of 24 bends were sampled during the 2004 field season (Figure 4). Upper Plattsmouth Bend and Upper Hamburg Bend which were non-randomly selected and Hemmis Bend and St. Joseph Bend which were randomly selected were sampled during both seasons. Three pallid sturgeon were sampled on St. Joseph Bend (R.M. 445.1 – 448.5) and two pallid

sturgeon were sampled on Upper Hamburg Bend (R.M. 554.5 – 554.6).

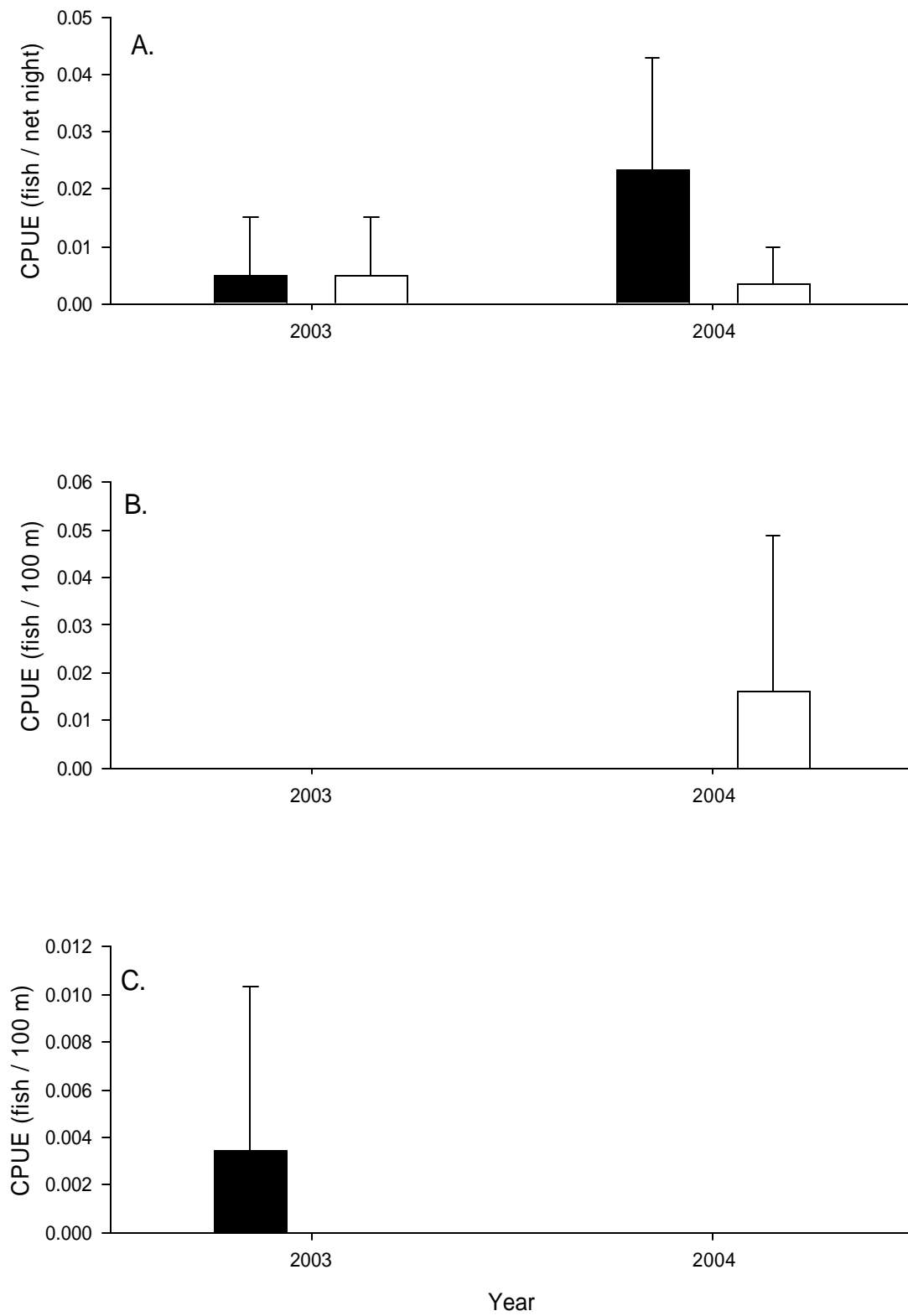


Figure 2. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars) and stocked (white bars) pallid sturgeon in segment 9 of the Missouri River for: A) gill nets, B) trammel nets and C) otter trawls during the sturgeon season during 2003 and 2004.

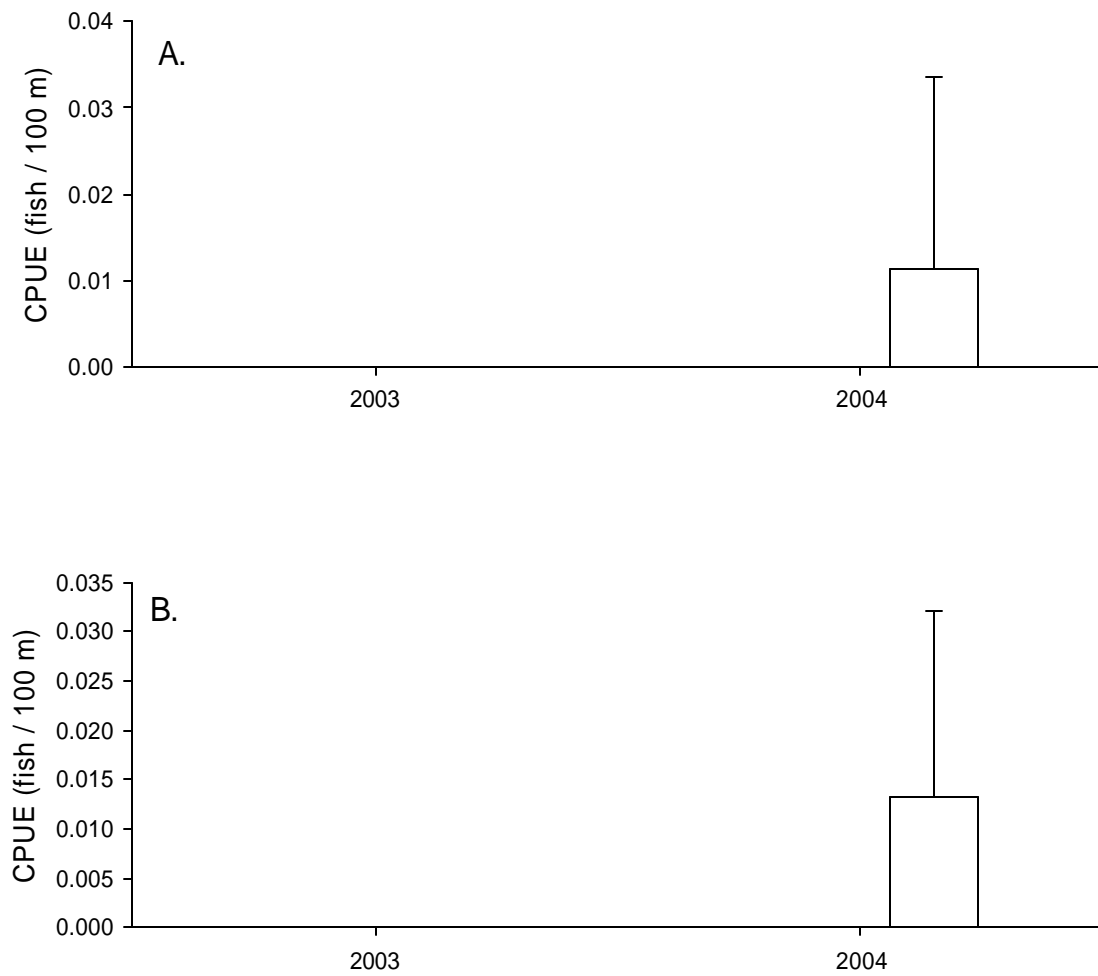


Figure 3. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars) and stocked (white bars) pallid sturgeon in segment 9 of the Missouri River for: A) trammel nets and B) otter trawls during the fish community season during 2003 and 2004.

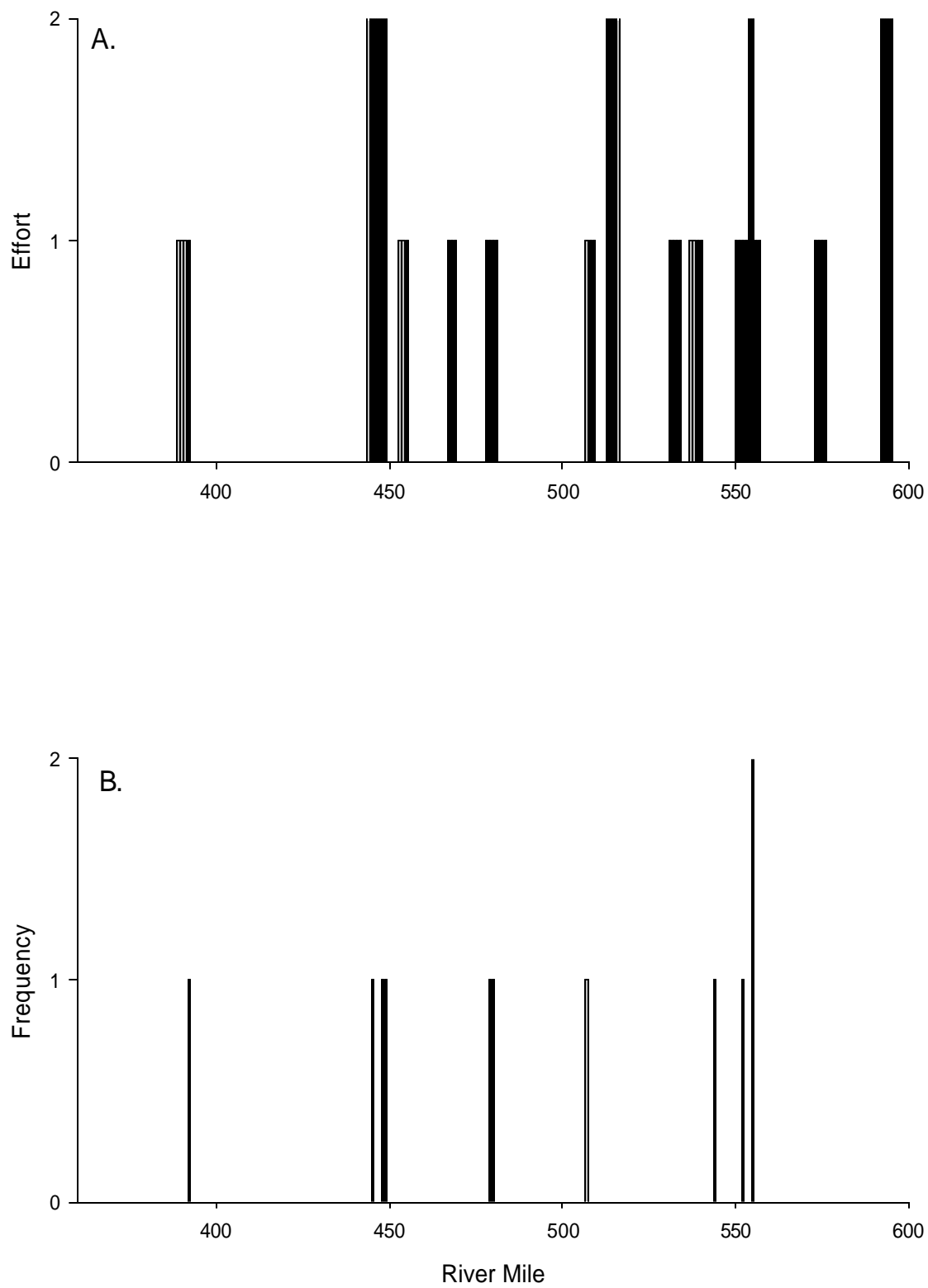


Figure 4. Distribution of: A) sampling effort and B) pallid sturgeon catch by river mile for segment 9 of the Missouri River during 2004. Sampling effort of 2 indicates river miles sample in both the sturgeon season and fish community season. Sampling effort of 1 indicates that river mile was only sampled in one season.

Objective 2. Document annual results and long-term trends of habitat usage of wild pallid sturgeon and hatchery stocked pallid sturgeon by season and life stage.

During the sturgeon season, one sub-stock pallid sturgeon (< 330 mm) was collected while trammel netting in channel cross-over macrohabitats (Figure 5) and channel border mesohabitats (Figure 6). Two stock size pallid sturgeon (330 – 629 mm) were collected during the same season with one being collected in outside bend macrohabitats and the other in inside bend macrohabitats. Both stock size pallid sturgeon were sampled in pool mesohabitats. Five pallid sturgeon were collected that were classified as greater than stock size (> 630 mm). Three were sampled in inside bend macrohabitats with the other two being sampled in channel cross-over macrohabitats and a secondary channel connected large macrohabitat. Four of the five pallid sturgeon greater than stock size were collected in pools mesohabitat.

During the fish community season, three pallid sturgeon were collected. Two were classified as sub-stock and one was classified as stock size. All fish were sampled in inside bend macrohabitat and the channel border mesohabitat.

Secondary channel connected large pools had the highest CPUE (0.17 fish per net-night) for pallid sturgeon during the sturgeon gill netting season, channel cross-over channel borders were second (0.04 fish per net-night) (Appendix E). The overall CPUE for pallid sturgeon during gill netting season was 0.03 fish per net-night. No pallid sturgeon were sampled using an otter trawl during the sturgeon season (Appendix F). Only one pallid sturgeon was sampled using a trammel net resulting in an overall CPUE of 0.02 fish per 100 m drifted (Appendix G). Otter trawling and trammel netting during the fish community season inside bend channel borders was the only habitat where pallid sturgeon were collected. This resulted in a CPUE of

0.02 fish per 100 m trawled/drifted (Appendix H and Appendix I). No pallid sturgeon were sampled using a bag seine (Appendix J) or mini-fyke net (Appendix K).

Pallid sturgeon were most frequently collected in inside bends macrohabitats. Seven of the eleven pallid sturgeon came from inside bends, with the remaining being sampled from channel cross-overs (2), outside bends (1) and secondary channel connected large (1) (Table 3). Nearly equal numbers of pallid sturgeon were sampled from pool (6) and channel border (5) mesohabitats. The average depth that pallid sturgeon were collected at was 2.85 meters with an average bottom velocity of 0.27 mps (Table 3). Sand was the dominate substrate ranging from 75% to 100%. Gravel was never present at the location of a pallid sturgeon capture. Turbidity ranged from 24 to 627 NTU and had a mean of 158 NTU.

The length of wild pallid sturgeon sampled ranged from 390 mm to 1,069 mm and hatchery reared ranged from 111 mm to 562 mm (Table 4). Wild pallid sturgeon weighed from 180 grams to 4,722 grams and hatchery reared from too small to get an accurate field weight to 428 grams. CI for wild pallid sturgeon ranged from -0.83 to -1.88. Recaptured hatchery reared fish were sampled from the Verdel, Bellevue, Leavenworth and Boonville stocking sites and originated from the Gavins Point Dam, Neosho and Garrison Dam National Fish Hatcheries.

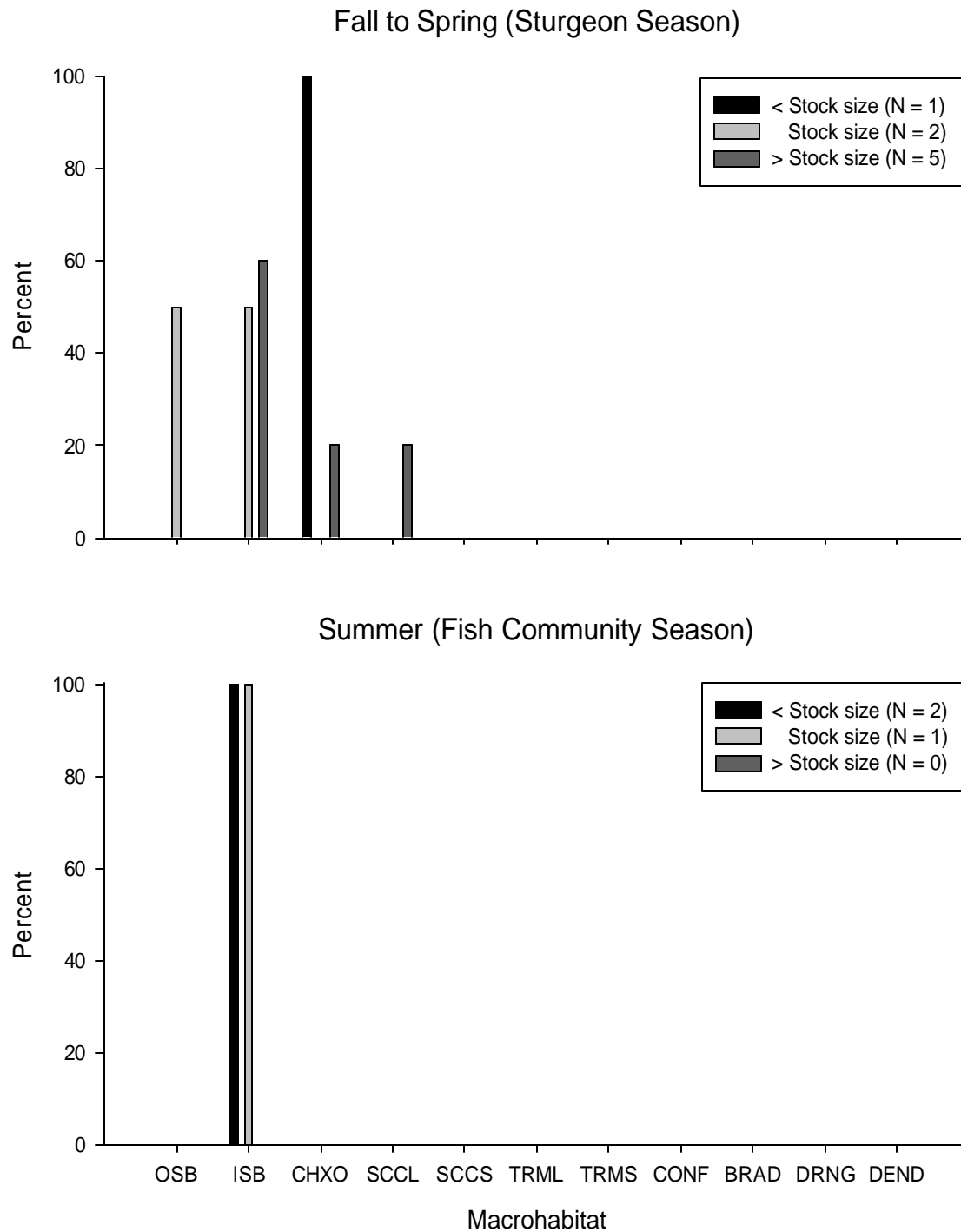


Figure 5. Percent of total pallid sturgeon for three size classes caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Size classes defined in the text and habitat abbreviations presented in Appendix B.

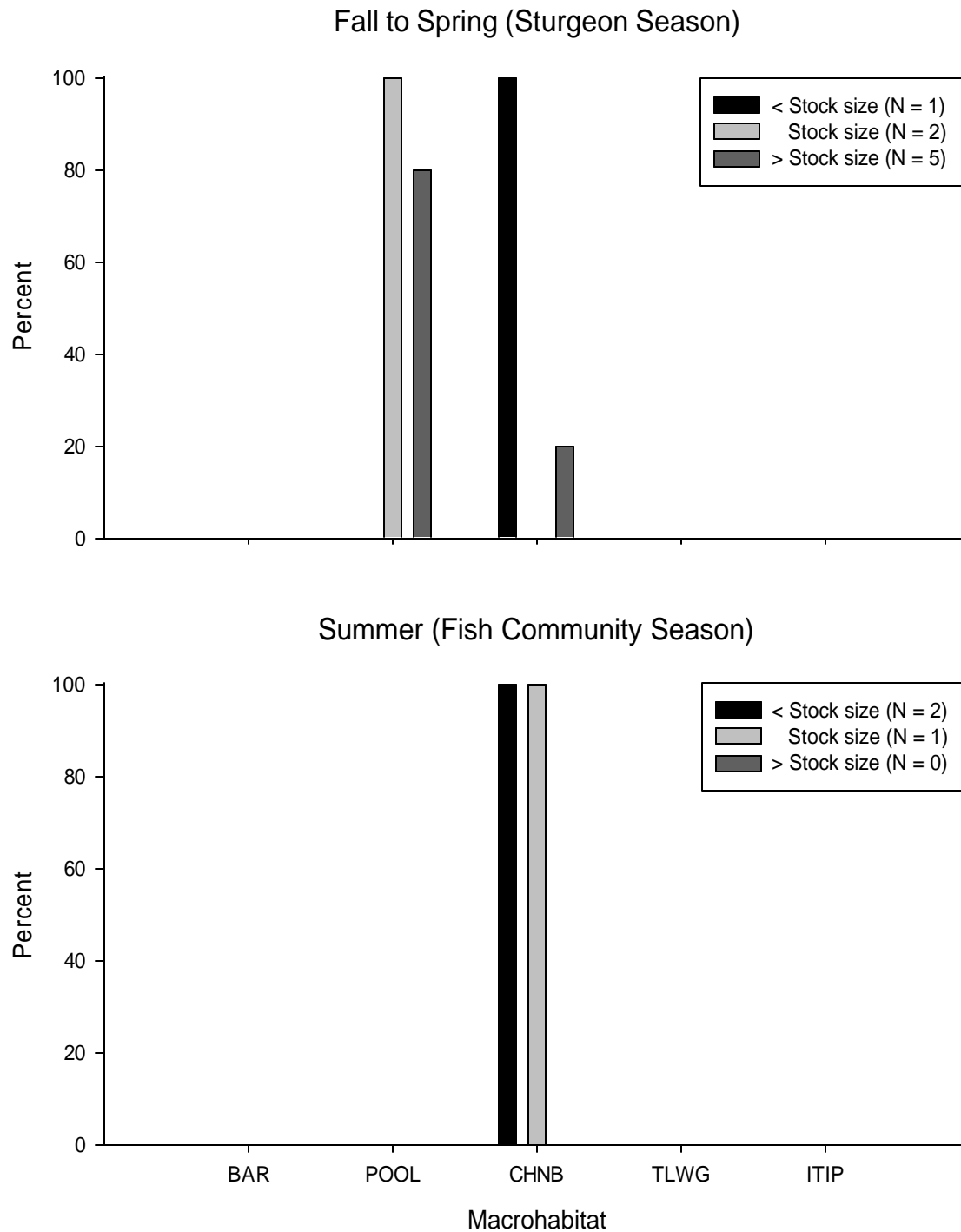


Figure 6. Percent of total pallid sturgeon for three size classes caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Size classes defined in the text and habitat abbreviations presented in Appendix B.

Table 3. Pallid sturgeon (PDSG) and hybrid sturgeon (SNPD) capture locations and habitat characteristics for segment 9 of the Missouri River during 2004. ID number links habitat information with individual fish length, weight, and tagging data in Table 4. Gear codes presented in Appendix C. Habitat definitions and codes presented in Appendix B.

Species	Date	Gear	Latitude (°)	Longitude (°)	River mile	Habitat			Water Temp (°C)	Turb ^a (NTU)	Depth ^b (m)	Bottom velocity (m/s)	Substrate ^c (silt/sand/ gravel)	ID#
						Macro-	Meso-	Micro-						
PDSG	11/10/03	GN14	40.61224	95.76254	554.5	SCCL	POOL	WDT	6	24	5.0	0.18	10 / 90 / 0	1
PDSG	11/11/03	GN81	40.14837	95.43272	506.5	OSB	POOL	RVSC	6	34	3.2	n/a	20 / 80 / 0	2
PDSG	3/10/04	GN81	39.91248	95.20557	480.0	CHXO	CHNB	WDI	6	627	1.4	0.12	0 / 100 / 0	3
PDSG	3/10/04	GN81	39.9008	95.18681	478.8	ISB	POOL	WDT	6	343	3.8	0.00	25 / 75 / 0	4
PDSG	3/22/04	GN18	39.72513	94.90547	445.1	ISB	POOL	WDT	9	86	3.6	0.12	0 / 100 / 0	5
PDSG	4/6/04	GN81	40.60691	95.75089	554.6	ISB	POOL	CVDC	12	54	1.8	0.59	0 / 100 / 0	6
PDSG	4/14/04	GN81	40.50526	95.69923	543.7	ISB	POOL	CVDB	11	80	2.9	0.08	0 / 100 / 0	7
PDSG	6/29/04	TN	39.76506	94.86270	448.5	CHXO	CHNB	WDI	23	150	3.0	0.32	0 / 100 / 0	8
PDSG	7/20/04	TN	39.72504	94.89955	447.7	ISB	CHNB	WDI	28	149	2.0	0.44	0 / 100 / 0	9
PDSG	10/4/04	OT16	39.26794	94.84688	391.7	ISB	CHNB	WDI	16	124	2.5	0.38	0 / 100 / 0	10
PDSG	10/12/04	OT16	40..57129	95.77345	551.5	ISB	CHNB	ODOT	17	68	2.2	0.54	0 / 100 / 0	11

^aTurb = turbidity.

^bDepths presented are the average of the starting, middle, and ending depths measured during gear deployment.

^cSubstrates are percents determined visually and by feel in the field.

Table 4. Pallid and hybrid sturgeon captured in segment 9 of the Missouri River during 2004. Recapture data includes: lengths (fork length [FL]), weights (wt), morphometric character index (CI) (Sheehan et al. 1999), status (H = hatchery, W = wild), tags found, elastomer tags (color, position, and orientation), and if tags were inserted in the field. Stocking history (if applicable) for each fish includes: year class, stocking length, weight, site, and hatchery source. The fish ID number links individual fish data with location and habitat data in Table 3.

ID #	Recapture data								Stocking data				
	FL (mm)	Wt (g)	CI	Status	Tags found ^a	Tag Number(s) ^{b,d}	Elastomer ^c	Marked in field? ^d	Year class	FL (mm)	Wt (g)	Site	Source
1	1027	3990	-1.63	W	none	412C296B72 (P)		Yes					
2	562	428	-1.29	H	P	424D2C0648 (P)		No	1999	488	406	BEL	GAV
3	840	1740	-1.88	W	none	412C450A06 (P)		Yes					
4	1013	4236	-1.27	W	none	412C5B1A28 (P)		Yes					
5	945	3414	-0.83	W	none	412C255708 (P)		Yes					
6	1069	4722	-0.96	W	none	412C20001A (P)		Yes					
7	390	180	-0.85	W	none	412C244F24 (P)		Yes					
8	248	32	n/a	H	E		Pink – R V	No	2003	n/a	n/a	BOO	GAR
9	409	194	n/a	H	P	431B302371 (P)		No	2001	210	n/a	VER	GAR
10	310	26	n/a	H	P,E	4349036D60 (P)	Yellow - R H	No	2003	258	50	LEA	NEO
11	111	n/a	n/a	H	E		Red – L H	No	2004	86	2	BOO	GAR

^aTag types include: coded wire tag (C), dangler tag (D), elastomer (E), floy (F), jaw tag (J), passive induced transponder tag, i.e., PIT tag (P), and self piercing tag (S)..

^bTag type in parentheses after number.

^cPostitons and orientations listed after each color can include: fish's right (R), fish's left (L), center of rostrum (C), vertical (V), and horizontal (H).

^dIf fish marked in the field, tag number corresponds to new tag and the type is in parentheses next to the tag number.

^eStocking site codes found in Appendix D.

^fHatchery sources: BOZ = Bozeman Fish Technology Center in MT, BPY = Blind Pony State Hatchery in MO, GAR = Garrison Dam National Fish Hatchery (NFH) in ND, GAV = Gavins Point Dam NFH in SD, MCY = Miles City State Fish Hatchery in MT, NAT = Natchitoches NFH in LA, NEO = Neosho NFH in MO and PEC = Fort Peck Dam State Fish Hatchery in MT.

Objective 3. Document population structure and dynamics of pallid sturgeon in the Missouri River System.

Eight pallid sturgeon were sampled during the sturgeon season with fork lengths from 248 to 1069 mm (Figure 7). Three pallid sturgeon were sampled during the fish community season with fork lengths from 111 to 409 mm.

Relative condition factor for all hatchery reared pallid sturgeon declined since stocking. From 0.95 to 0.60 for the one pallid sturgeon collected from the 1999 year class and from an average of 0.95 to 0.64 for the two pallid sturgeon collected from the 2003 year class (Table 5). The pallid sturgeon from the 1999 year class that was sampled during gill netting season was noticeably thin, while the remaining four recaptures appeared healthy.

The PSD value for wild pallid sturgeon was 83 during the sturgeon season (Table 6). The RSD preferred value was 67 and the RSD memorable value was 17 for wild pallid sturgeon. PSD and RSD values for stocked pallid sturgeon could not be calculated due to the lack of fish sampled that were greater than stock size.

Over 1,000 samples were collected from the Missouri River between the Platte River and the Kansas River during the 2004 sampling year. A total of 3,080 river sturgeon were collected. This results in a pallid sturgeon to shovelnose sturgeon ratio of 1:279 (Table 7). One hybrid was sampled, resulting in a ratio of 11:1 pallid sturgeon to hybrid sturgeon. Of the eleven pallid sturgeon sample, 6 were classified as wild (awaiting the results of genetic testing) and 5 contained some type of tag.

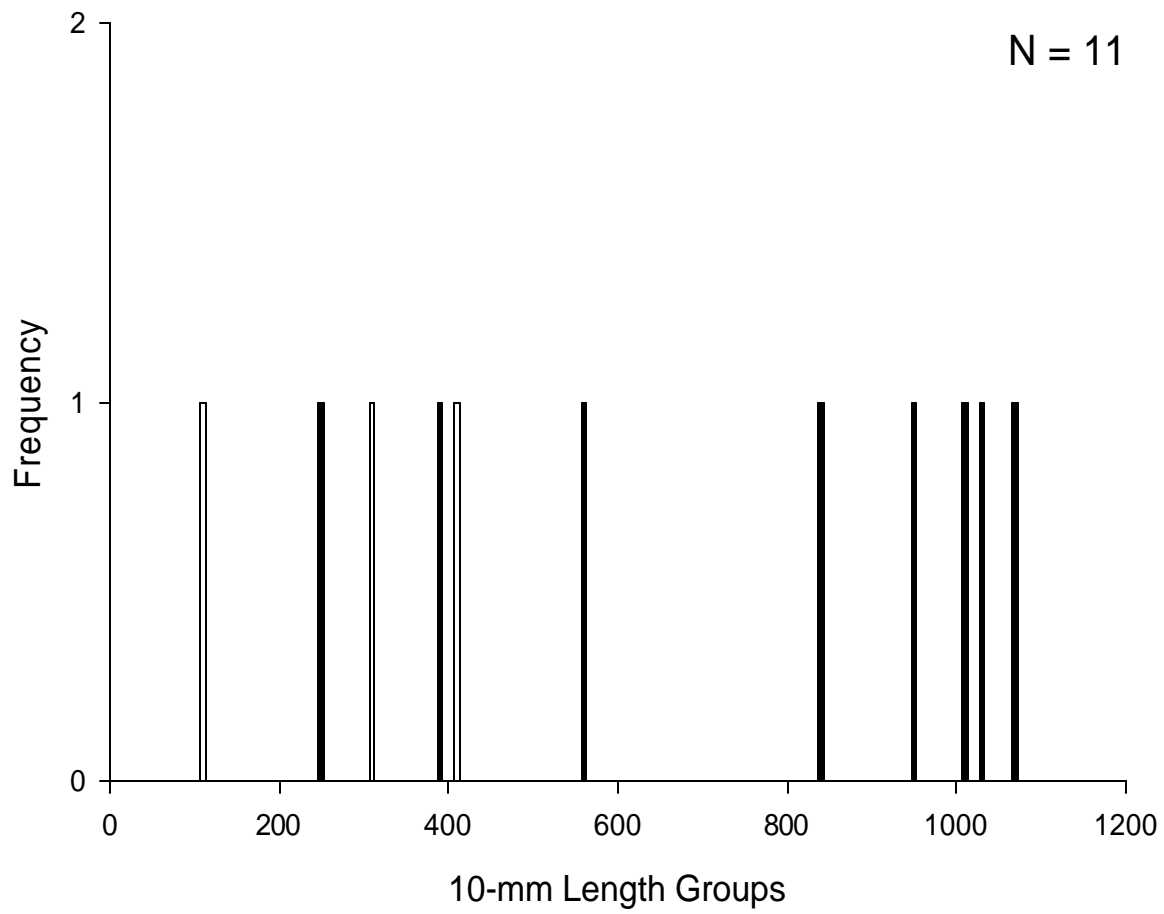


Figure 7. Length frequency of pallid sturgeon during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Table 5. Mean fork length (SE), weight (SE), relative condition factor (Kn) and growth rates of juvenile hatchery-reared pallid sturgeon by year class at the time of stocking and recapture in 2004 for segment 9 of the Missouri River. Relative condition factor was calculated using the equation in Keenlyne and Evanson (1993).

Year class	N	Stocking Data			Recapture Data			Growth (mm/d)	Growth (g/d)
		Length (mm)	Weight (g)	Kn	Length (mm)	Weight (g)	Kn		
1999	1	488	406	0.95	562	428	0.60	0.1973	0.0587
2001	1	210			409	194	0.79	0.2424	
2003	2	258	50	0.95	279 (31.0)	44 (12.0)	0.64 (0.06)	0.7879	0.0909
2004	1	86	2	1.53	111			0.7813	

Table 6. Relative stock density (RSD)^a by length category for wild and stocked pallid sturgeon in segment 9 of the Missouri River captured during 2004. Length categories^b determined using the methods proposed by Gablehouse (1984).

Length Category	Wild		Stocked	
	N	RSD	N	RSD
Sturgeon Season				
Sub-stock			1	
Stock	6		1	
Quality	5	83		
Preferred	4	67		
Memorable	1	17		
Trophy				
Fish Community Season				
Sub-stock			2	
Stock			1	
Quality				
Preferred				
Memorable				
Trophy				

^aRSD = number of fish = specified length ÷ number of fish = minimum stock length x 100.

^bLength categories based on the percentage of the largest known pallid sturgeon: sub-stock FL < 330 mm (20%), Stock FL = 330 – 629 mm (20 - 36%), Quality FL = 630 – 839 mm (36 - 45%), Preferred FL = 840 – 1039 mm (45 - 59%), Memorable FL = 1040 – 1269 mm (59 - 74%), Trophy FL > 1270 mm (> 74%).

Table 7. Ratios of pallid sturgeon to shovelnose sturgeon, pallid sturgeon to hybrids (pallid X shovelnose), and stocked pallid sturgeon to wild pallid sturgeon captured in segment 9 of the Missouri River during 2004.

Pallid:Shovelnose	Pallid:Hybrid	Stocked:Wild
1:279	11:1	6:5

Missouri River Fish Community

I. Targeted Native Missouri River Species

Objective 4. Document annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River System.

Objective 5. Document annual results and long-term trends of habitat usage of the target native species by season.

Shovelnose sturgeon

Catch per unit effort for shovelnose sturgeon during the sturgeon gill net season dropped from 12.0 fish per net-night in 2003 to 6.9 fish per net-night in 2004 (Figure 8). Catch per unit effort for trammel netting during the sturgeon season increased from 1.5 fish per 100 m drifted in 2003 to 1.9 fish per 100 m drifted in 2004. Catch per unit effort for otter trawling during the sturgeon season remained relatively constant 0.9 fish per 100 m trawled in 2003 compared to 0.8 fish per 100 m trawled for 2004.

Catch per unit effort for trammel netting during the fish community season increased from 1.6 fish per 100 m drifted in 2003 to 3.5 fish per 100 m drifted in 2004 (Figure 9). Catch per unit effort for otter trawling during the fish community season increased from 0.7 fish per 100 m trawled in 2003 to 1.0 fish per 100 m trawled in 2004.

Over 2,000 shovelnose sturgeon were sampled in 289 net-nights during the sturgeon season while gill netting (Appendix E). Confluence pools had the highest CPUE (14.3 fish per net-night), secondary connected channel large pools were second (13.9 fish per net-night) and channel cross-over pools were third (13.7 fish per net-night). Channel borders associated with outside bends, inside bends and channel cross-overs had the lowest CPUE with less than three shovelnose per net-night.

Only 85 shovelnose sturgeon were sampled during the sturgeon season using an otter trawl (Appendix F). Secondary channel connect large channel border had the highest CPUE (3.7 fish per 100 m trawled), outside bend channel borders were second (1.4 fish per 100 m trawled) and tributary mouth large channel borders were third (1.3 fish per 100 m trawled). Channel borders associated with inside bends, secondary channel connected small and confluence had the lowest CPUE with less than one shovelnose per 100 m trawled.

Two hundred twenty-one shovelnose sturgeon were sampled during the sturgeon season while drifting trammel nets (Appendix G). Secondary channel connect large channel borders had the highest CPUE (21.6 fish per 100 m drifted) and confluence channel borders were second (13.2 fish per 100 m drifted). Channel borders associated with inside bends and channel cross-overs produced the lowest CPUE with 1.2 fish per 100 m drifted and 0.9 fish per 100 m drifted, respectively.

One hundred thirty-nine shovelnose sturgeon were sampled during the fish community season using an otter trawl (Appendix H). Confluence channel borders had the highest CPUE (2.3 fish per 100 m trawled) and outside bend channel borders were second (2.1 fish per 100 m trawled). Channel borders associated with inside bends and tributary mouth large produced the lowest CPUE with less than one shovelnose per 100 m trawled.

Three hundred sixty-nine shovelnose sturgeon were sampled during the fish community season while drifting trammel nets (Appendix I). Secondary channel connect large channel border had the highest CPUE (20.8 fish per 100 m drifted) and inside bend channel borders were second (3.0 fish per 100 m drifted). Channel borders associated with channel cross-overs and confluences had the lowest CPUE with 1.5 fish per 100 m drifted and 0.7 fish per 100 m drifted,

respectively. No shovelnose sturgeon were sampled using a bag seine (Appendix J) or mini-fyke nets (Appendix K).

Almost 99% of the shovelnose sturgeon sampled during the sturgeon season were greater than stock size (> 380 mm) (Figure 10). The majority of all three length categories were collected on the inside bend macrohabitat for both sampling seasons. Sub-stock shovelnose sturgeon (< 250 mm) and greater than stock size shovelnose sturgeon were mainly collected in pool mesohabitats during the sturgeon season, while pools and channel border mesohabitats were similar for stock sized shovelnose sturgeon (250 mm to 379 mm) (Figure 11). The majority of the shovelnose sturgeon collected from all three length categories during the fish community season were collected in the channel border mesohabitat.

A total of 3,069 shovelnose sturgeon were sampled during 2004, 2,525 during the sturgeon season. The average fork length was 551 mm (median = 558 mm) for the sturgeon season compared to an average fork length of 504 mm (median = 542 mm) for the fish community season (Figure 12). The length range for shovelnose sturgeon sampled during the sturgeon season was 197 to 747 mm compared to 40 to 707 mm for the fish community season.

The PSD value for shovelnose sturgeon was 99 during the sturgeon season and 98 during the fish community season (Table 8). The RSD preferred value was 79 and the RSD memorable value was 5 during the sturgeon season, but declined to RSD preferred of 74 and RSD memorable of 2 for the fish community season.

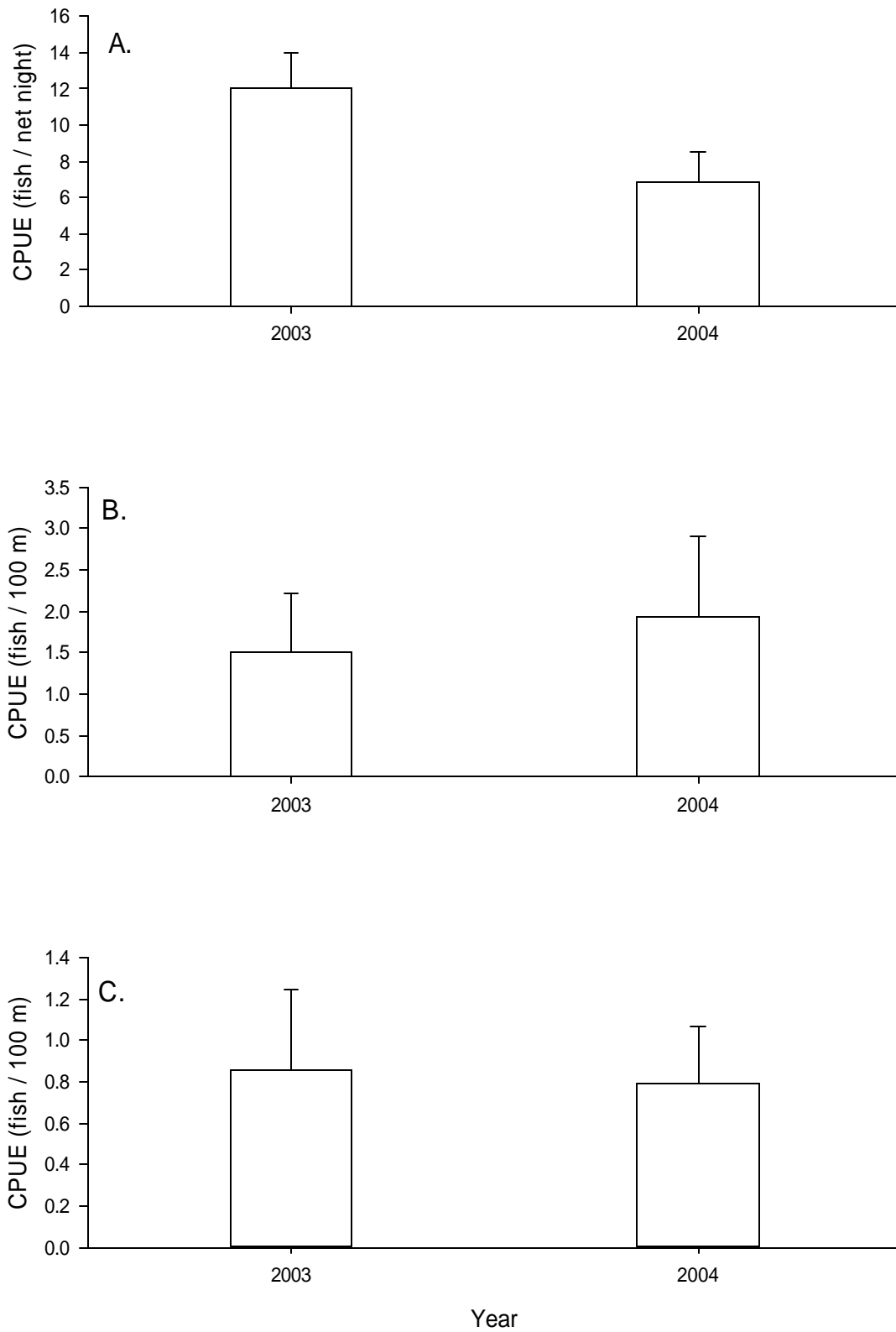


Figure 8. Mean annual catch-per-unit-effort (± 2 SE) of shovelnose sturgeon in segment 9 of the Missouri River for: A) gill nets, B) trammel nets and C) otter trawls during the sturgeon season during 2003 and 2004.

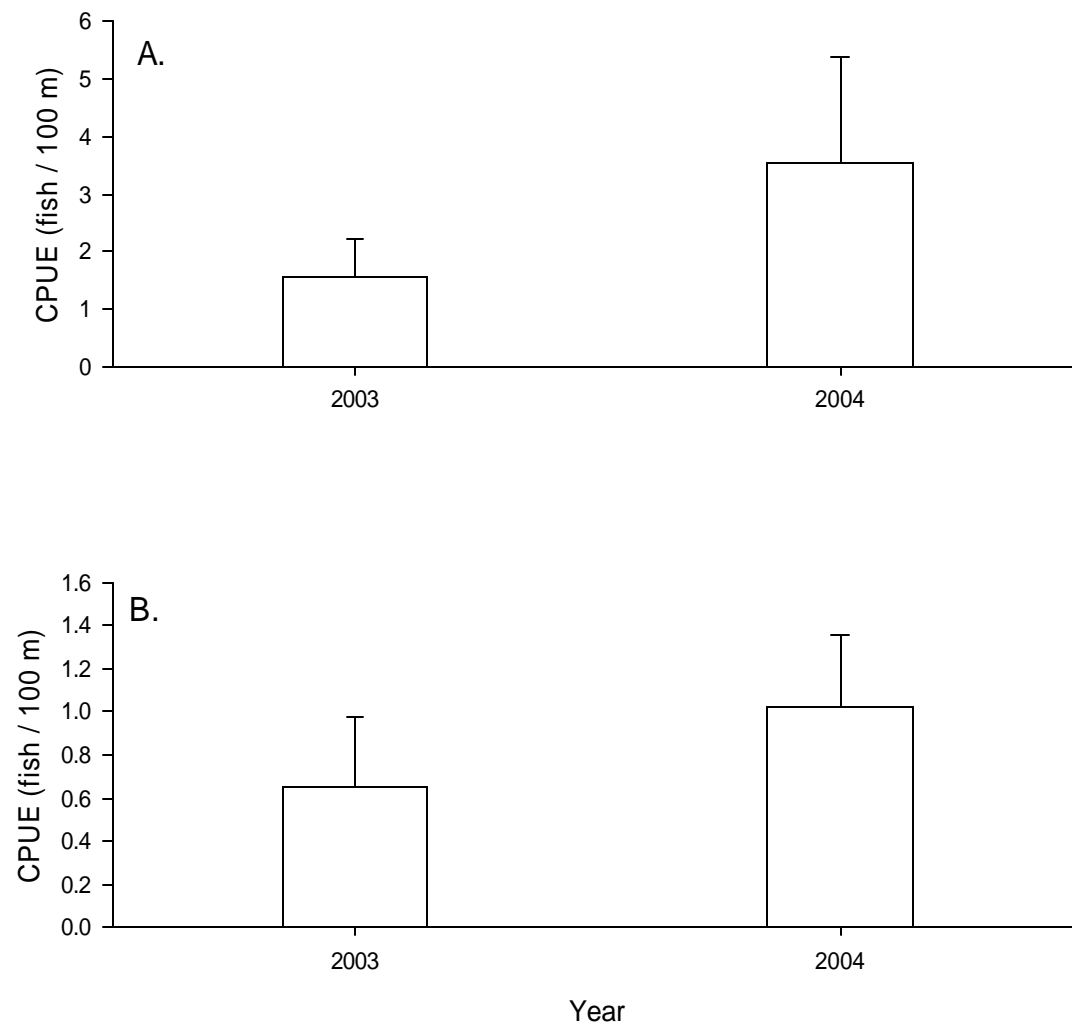


Figure 9. Mean annual catch-per-unit-effort (± 2 SE) of shovelnose sturgeon in segment 9 of the Missouri River for: A) trammel nets and B) otter trawls during the fish community season during 2003 and 2004.

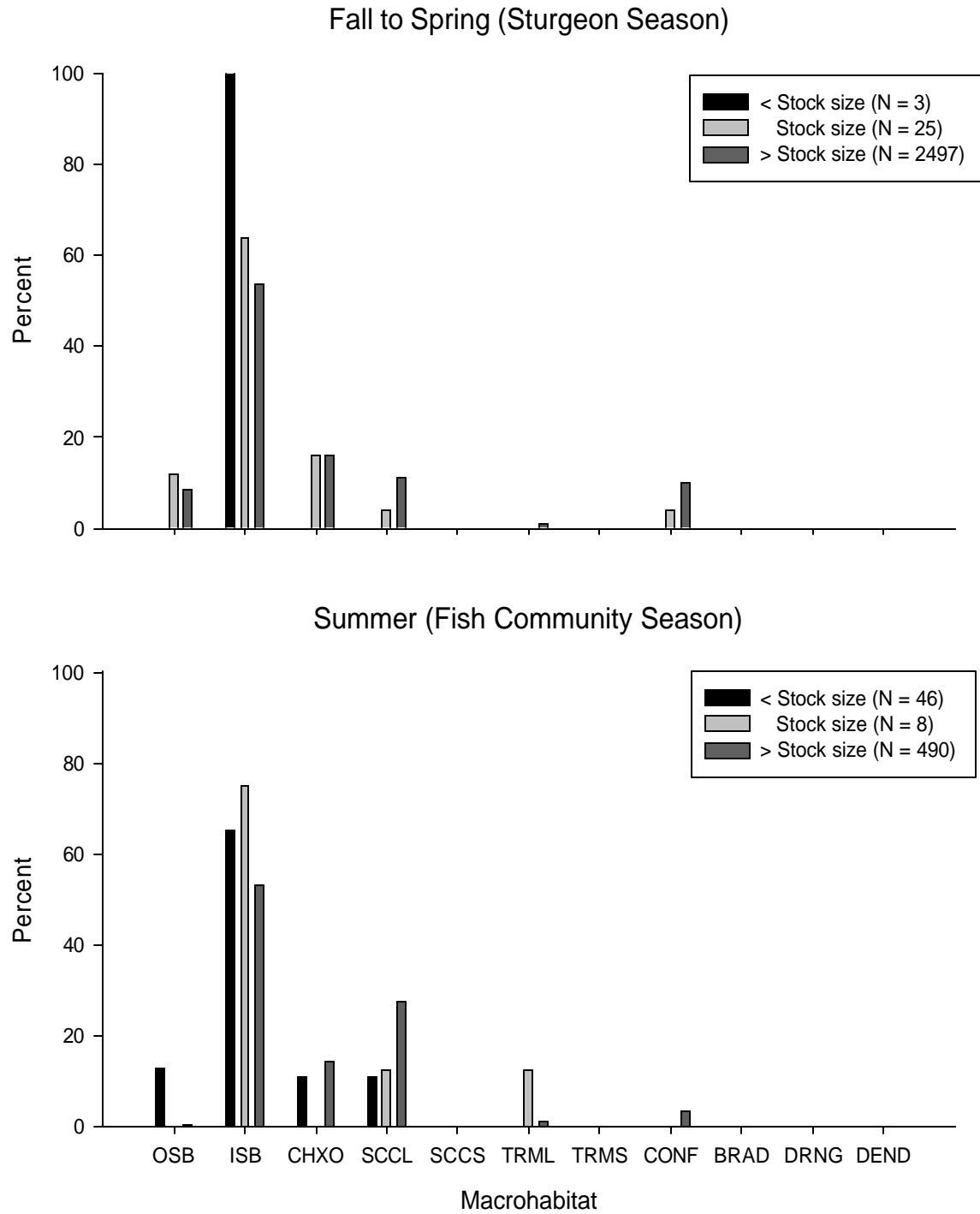


Figure 10. Percent of total shovelnose sturgeon for three size classes caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Size classes defined in the text and habitat abbreviations presented in Appendix B.

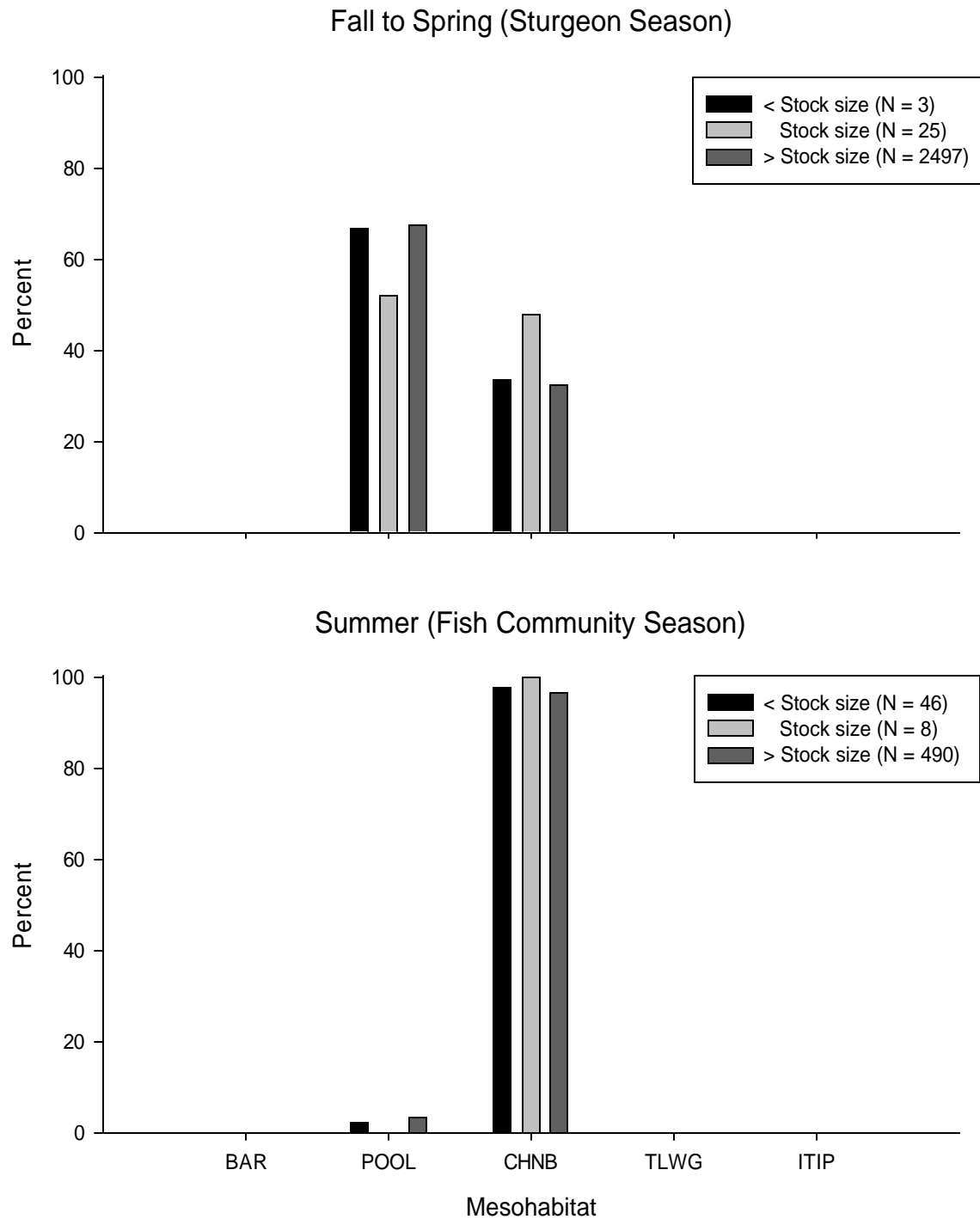


Figure 11. Percent of total shovelnose sturgeon for three size classes caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Size classes defined in the text and habitat abbreviations presented in Appendix B.

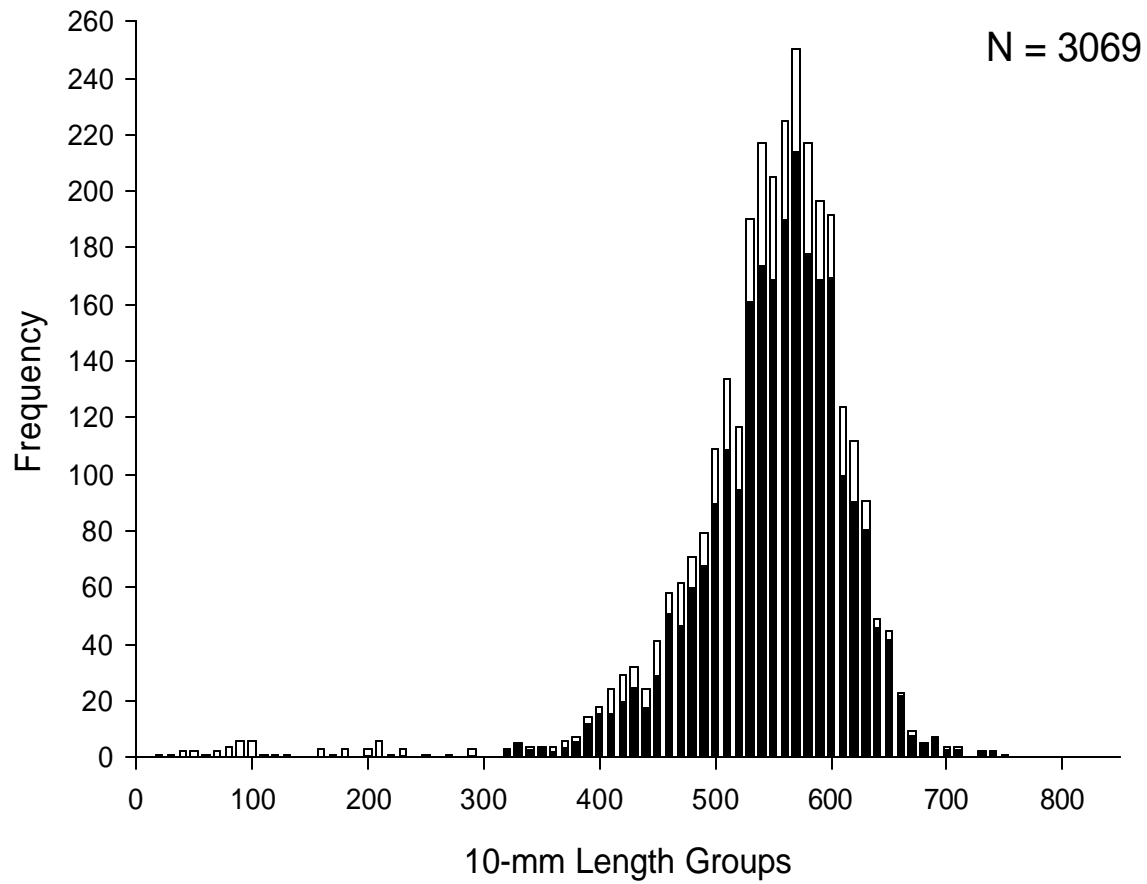


Figure 12. Length frequency of shovelnose sturgeon during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Table 8. Relative stock density (RSD)^a by length category of shovelnose sturgeon in segment 9 of the Missouri River captured during 2004. Length categories^b based on the system proposed by Quist et al. (1998).

Length category	N	RSD
Sturgeon Season		
Sub-stock	3	
Stock	2522	
Quality	2495	99
Preferred	1992	79
Memorable	121	5
Trophy		
Fish Community Season		
Sub-stock	46	
Stock	498	
Quality	490	98
Preferred	368	74
Memorable	9	2
Trophy		

^aRSD = number of fish = specified length ÷ number of fish = minimum stock length x 100.

^bLength categories based on the percentage of the largest known shovelnose sturgeon: Sub-stock FL < 250 mm (20%), Stock FL = 250 – 379 mm (20 - 36%), Quality FL = 380 – 509 mm (36 - 45%), Preferred FL = 510 – 639 mm (45 - 59%), Memorable FL = 640 – 809 mm (59 - 74%), Trophy FL = 810 mm (> 74%).

Native cyprinids

Sturgeon chub

Catch per unit effort for otter trawling during the sturgeon season remained relatively constant with a CPUE of 0.05 fish per 100 m trawled in 2003 compared to 0.03 fish per 100 m trawled in 2004 (Figure 13). Catch per unit effort for otter trawling during the fish community season increased from 0.03 fish per 100 m trawled in 2003 to 0.12 fish per 100 m trawled in 2004.

During the 2004 fish community season, 0.02 sturgeon chubs per 100 m² were sampled with seines compared to none in 2003 (Figure 14). No sturgeon chub were sampled while miniflyke netting during the 2003 or 2004 fish community season.

Only four sturgeon chubs were sampled during the sturgeon season using an otter trawl (Appendix F). All were sampled on an inside bend channel border resulting in a CPUE of 0.05 fish per 100 m trawled. Seventeen sturgeon chubs were sampled during the fish community season using an otter trawl (Appendix H). Secondary channel connected large channel borders had the highest CPUE (0.80 fish per 100 m trawled) and inside bend channel borders were second (0.12 fish per 100 m trawled). Bag seining during the fish community season resulted in the collection of two sturgeon chubs. Both were sampled on the inside bend bars resulting in a CPUE of 0.03 fish per 100 m².

All sturgeon chubs sampled during the sturgeon season were collected from inside bend macrohabitats (Figure 15) and were most frequently sampled within the channel border mesohabitats (Figure 16). The majority of sturgeon chubs collected during the fish community season was sampled on inside bend macrohabitats (60%), followed by secondary connected

channel large (37%). Almost 90% of the sturgeon chubs during the fish community season were collected from channel border mesohabitats.

A total of 24 sturgeon chubs were sampled during 2004, with 5 being sampled during the sturgeon season. The average fork length was 63.6 mm during the sturgeon season and 44.6 mm during the fish community season (Figure 17). The length range for sturgeon chubs sampled during the sturgeon season was 50 to 82 mm compared to 25 to 103 mm during the fish community season.

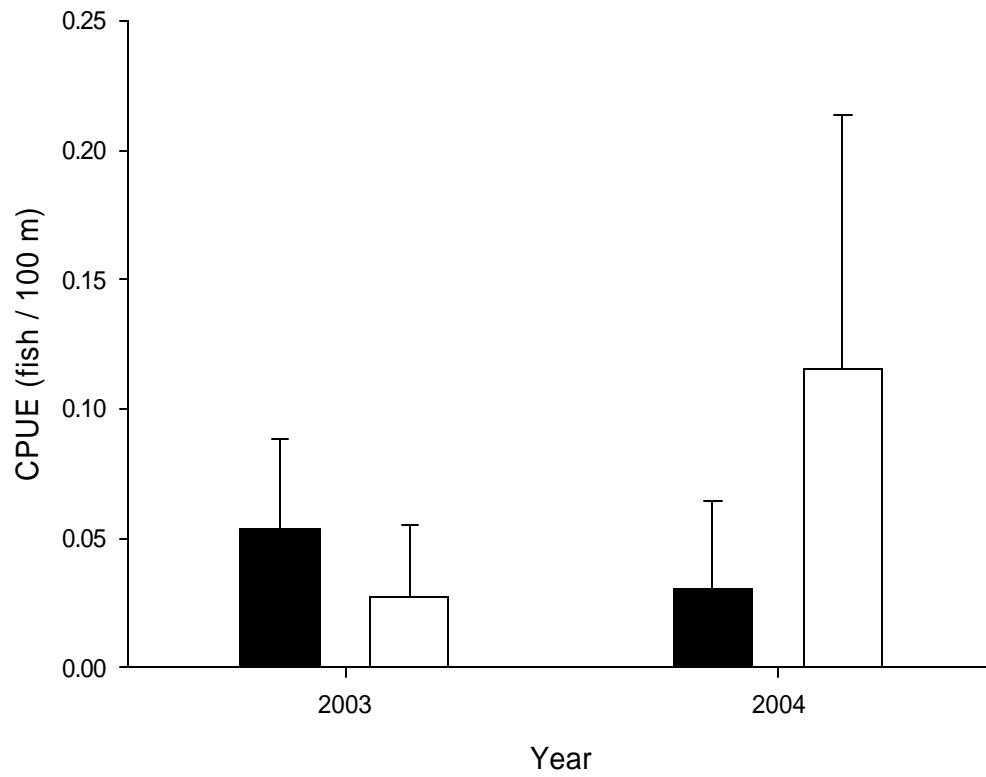


Figure 13. Mean annual catch-per-unit-effort (± 2 SE) of sturgeon chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River for otter trawling during 2003 and 2004.

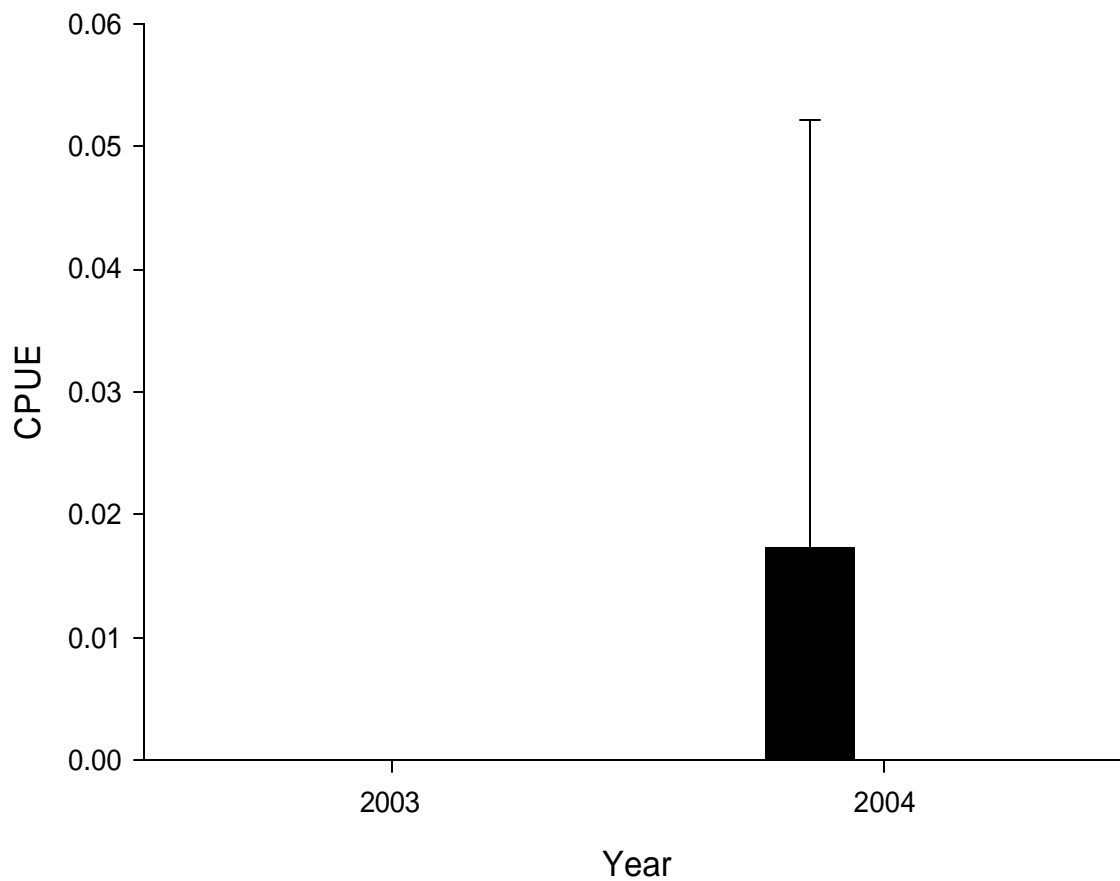


Figure 14. Mean annual catch-per-unit-effort (± 2 SE) of sturgeon chubs during the fish community season in segment 9 of the Missouri River for seining (black bars) and mini-fyke netting (white bars) during 2003 and 2004.

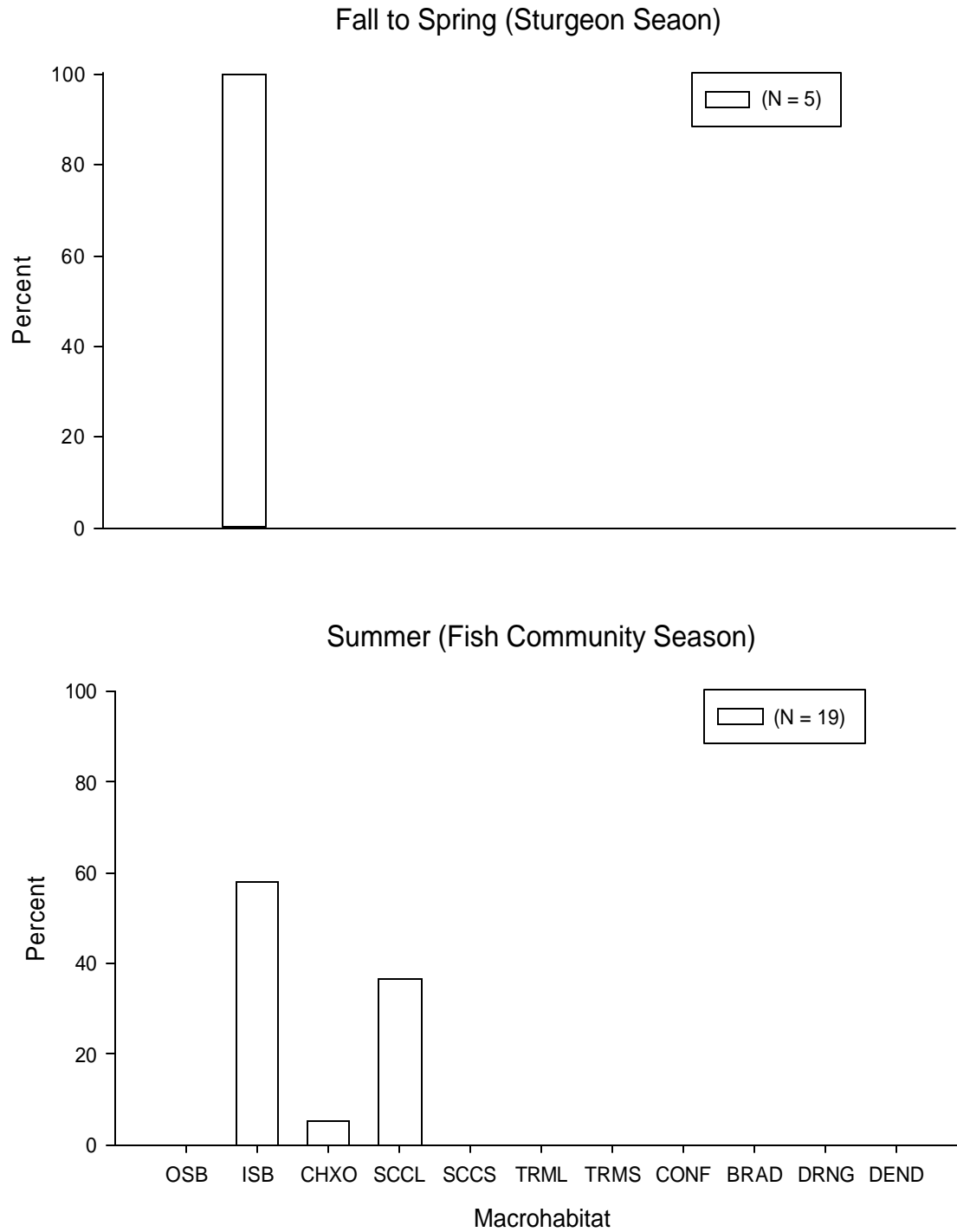


Figure 15. Percent of total sturgeon chubs caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

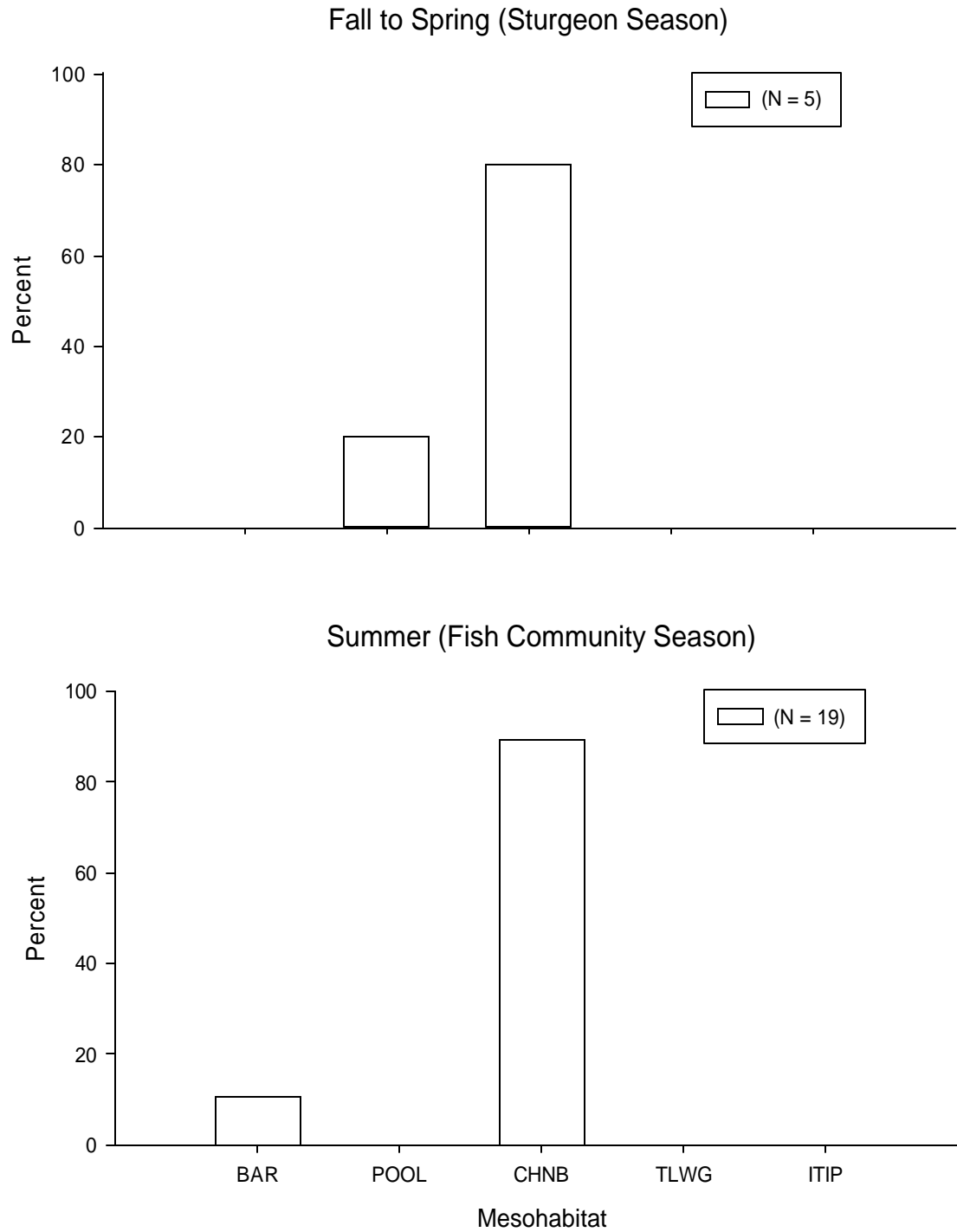


Figure 16. Percent of total sturgeon chubs caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

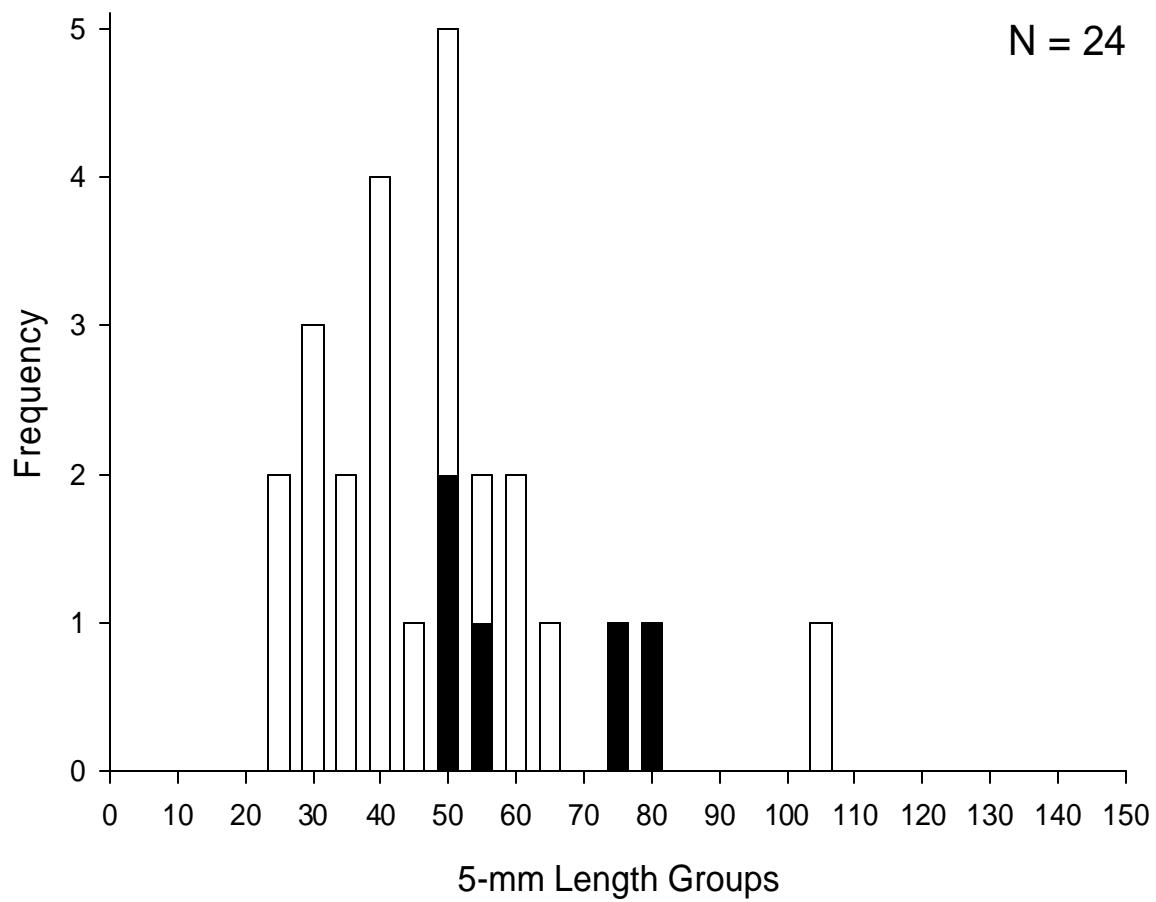


Figure 17. Length frequency of sturgeon chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Sicklefin chub

Catch per unit effort for otter trawling during the sturgeon season increased from 0.02 fish per 100 m trawled in 2003 to 0.14 fish per 100 m trawled in 2004 (Figure 18). Catch per unit effort for otter trawling during the fish community season increased from 0.06 fish per 100 m trawled in 2003 to 0.08 fish per 100 m trawled in 2004.

No sicklefin chub were sampled while seining or mini-fyke netting during the 2003 or 2004 fish community season (Figure 19).

Sixteen sicklefin chubs were sampled during the sturgeon season using an otter trawl (Appendix F). Secondary channel connected small channel borders had the highest CPUE of 1.02 fish per 100 m trawled. Sicklefin chubs were also collected on inside bends and channel cross-over channel borders but with a relatively low CPUE of 0.16 fish per 100 m trawled and 0.07 fish per 100 m trawled, respectively. Thirteen sicklefin chubs were sampled during the fish community season using an otter trawl (Appendix H). Tributary mouth large channel borders had the highest CPUE (0.17 fish per 100 m trawled) and channel cross-over channel borders were second (0.10 fish per 100 m trawled). Channel borders within inside bends had the lowest CPUE with 0.09 sicklefin chubs per 100 meters trawled.

Almost 65% of all the sicklefin chubs sampled during the sturgeon season were collected on the inside bends (Figure 20) and were most frequently sampled within the channel borders mesohabitat (94%) (Figure 21). The majority of sicklefin chubs collected during the fish community season was sampled on the inside bends macrohabitats (60%), followed by channel cross-overs (35%). Over 76% of the sicklefin chubs during the fish community season were collected from channel border mesohabitats.

A total of 34 sicklefin chubs were sampled during 2004, with 17 being sampled during each season. The average fork length was 56.4 mm during the sturgeon season and 54.3 mm during the fish community season (Figure 17). The length range for sicklefin chubs sampled during the sturgeon season was 37 to 103 mm compared to 23 to 94 mm for the fish community season.

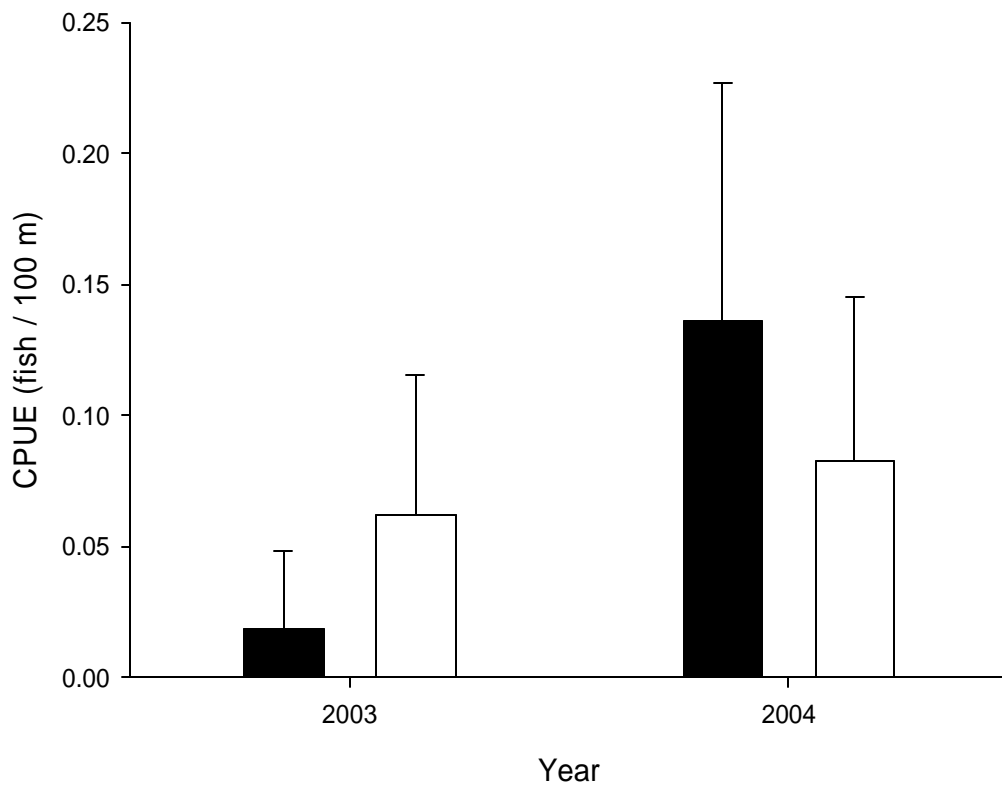


Figure 18. Mean annual catch-per-unit-effort (± 2 SE) of sicklefin chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River for otter trawling during 2003 and 2004.

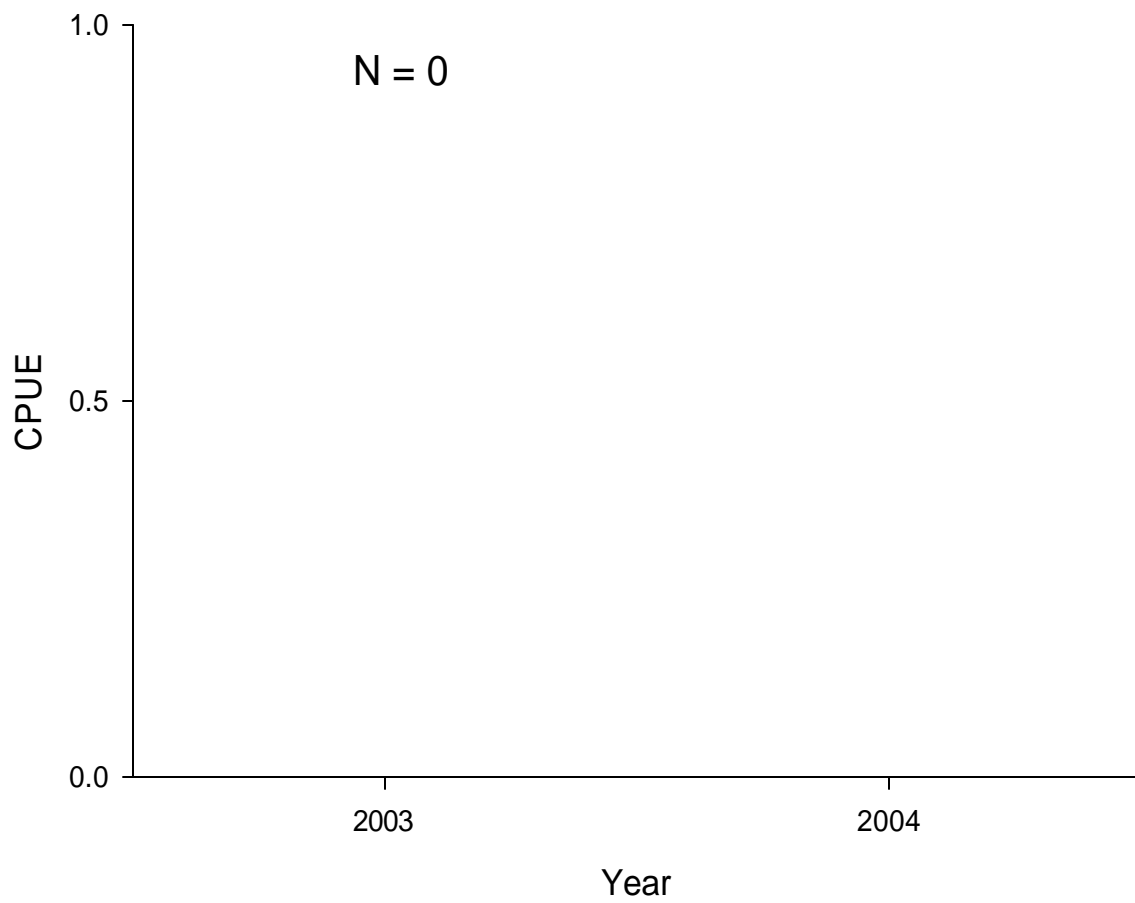


Figure 19. Mean annual catch-per-unit-effort (± 2 SE) of sicklefin chubs during the fish community season in segment 9 of the Missouri River for seining (black bars) and mini-fyke netting (white bars) during 2003 and 2004.

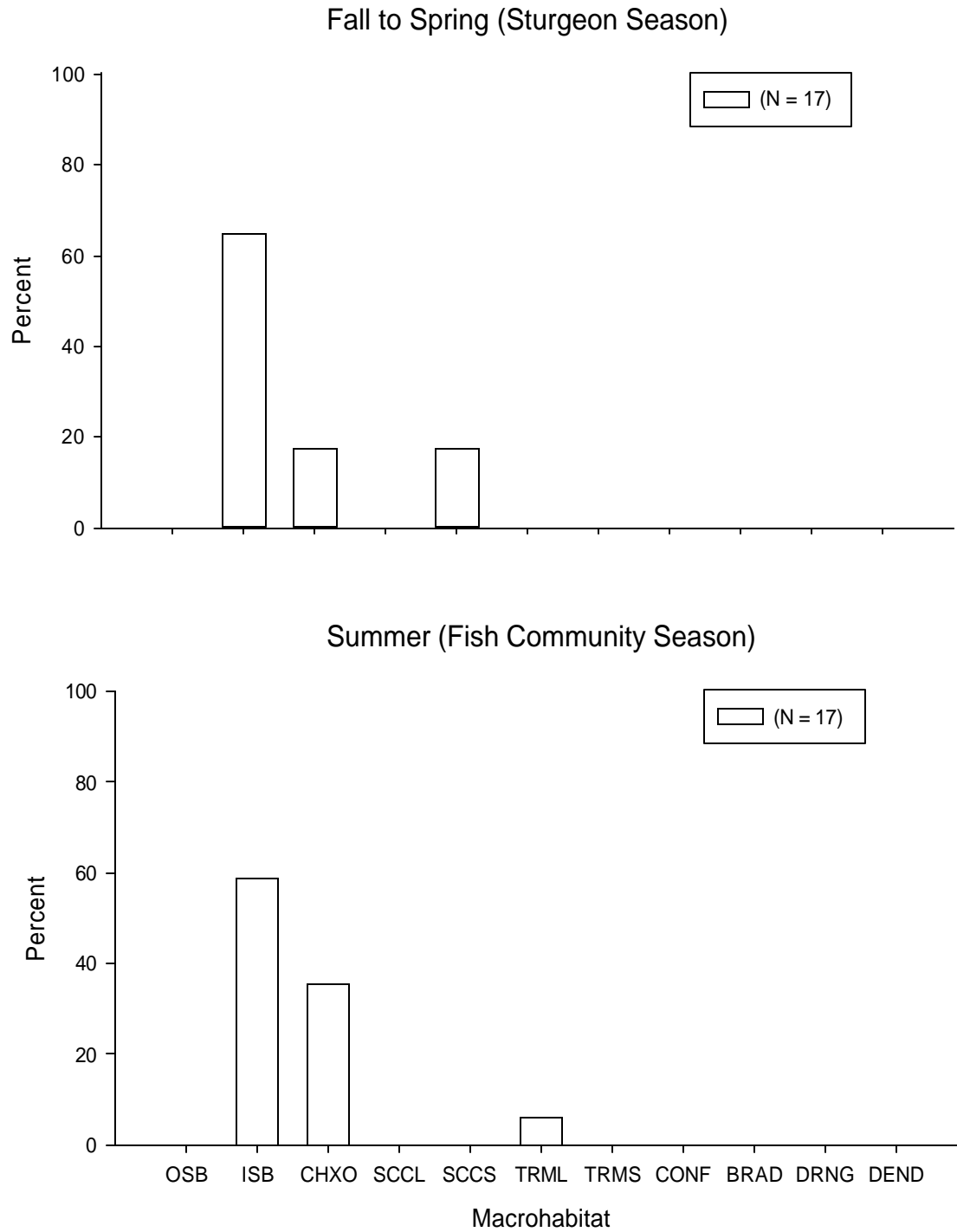


Figure 20. Percent of total sicklefin chubs caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

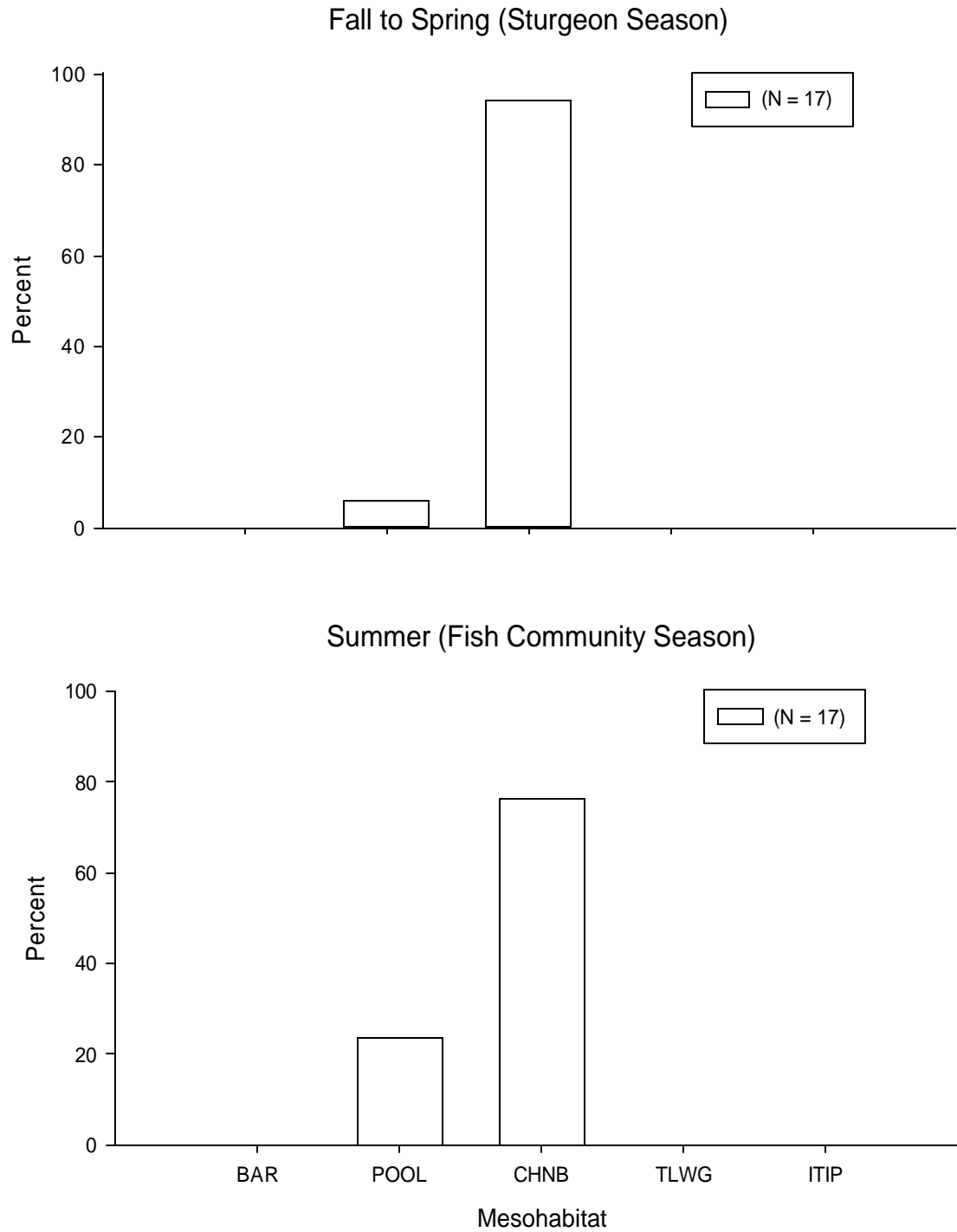


Figure 21. Percent of total sicklefin chubs caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

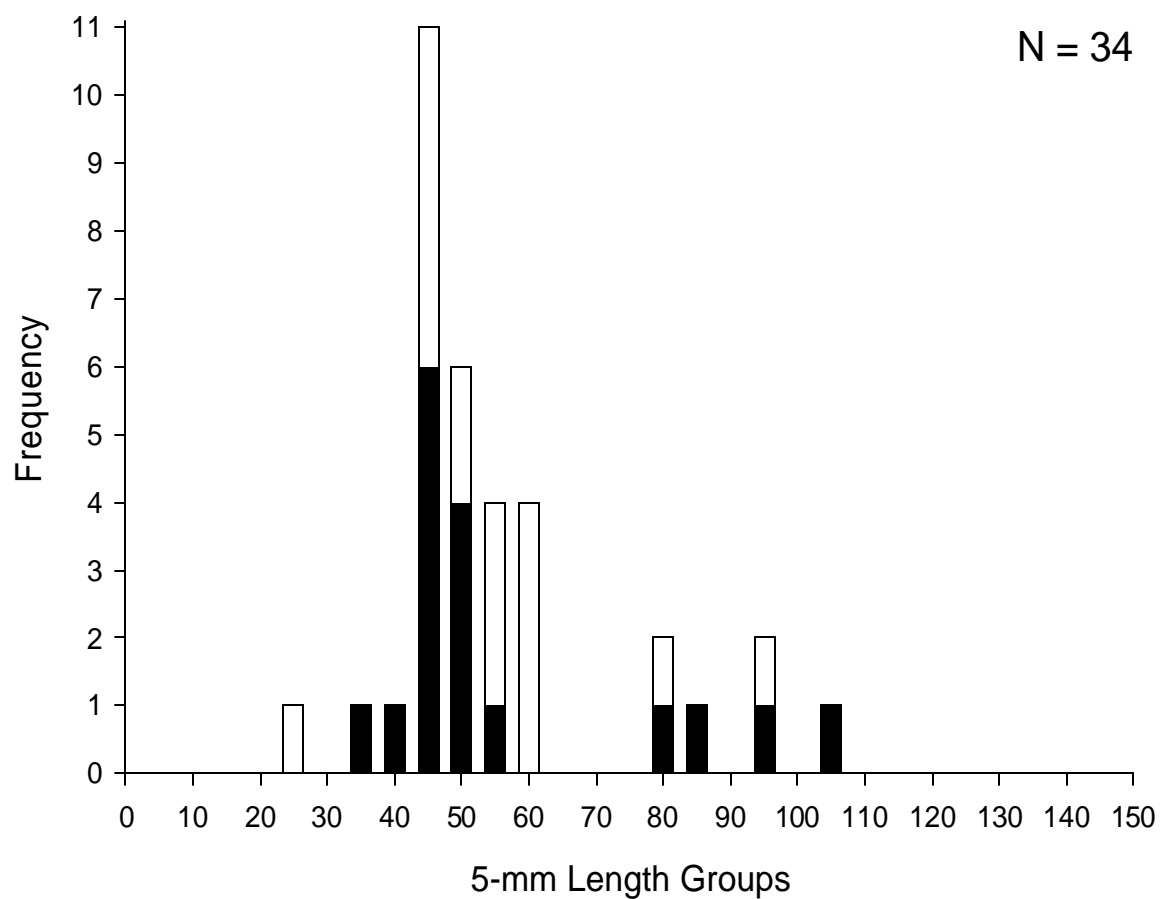


Figure 22. Length frequency of sicklefin chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Speckled chub

Catch per unit effort for otter trawling during the sturgeon season increased from 0.3 fish per 100 m trawled in 2003 to 0.7 fish per 100 m trawled in 2004 (Figure 23). Catch per unit effort for otter trawling during the fish community season increased from 0.5 fish per 100 m trawled in 2003 to 1.1 fish per 100 m trawled in 2004.

Seining during the fish community season resulted in the same CPUE of 0.02 for 2003 and 2004 (Figure 24). However, mini-fyke nets went from collecting zero fish during 2003 to collecting twenty-three speckled chubs during 2004. This resulted in a CPUE of 0.3 fish per net-night.

Sixty-nine speckled chubs were sampled during the sturgeon season using an otter trawl (Appendix F). Secondary channel connected small channel borders had highest CPUE (1.4 fish per 100 m trawled) and secondary channel connected large channel borders were second (0.8 fish per 100 m trawled). Speckled chubs were also collected on inside bend and channel cross-over channel borders and with a lower CPUE of 0.7 fish per 100 m trawled and 0.70 fish per 100 m trawled, respectively. Speckled chubs were sampled more abundantly during the fish community season using an otter trawl (Appendix H) with a total of 140 collected. Secondary channel connect large channel borders had the highest CPUE (1.2 fish per 100 m trawled) and inside bend channel borders were second (1.20 fish per 100 m trawled). Channel borders within tributary mouth large and confluences had the lowest CPUE with 0.2 speckled chubs per 100 meters trawled. Only two speckled chubs were sampled while seining, and both were sampled on the inside bend bars with a CPUE of 0.05 (Appendix J). Inside bend bars had a CPUE of 0.4 fish per net-night compared to 0.2 fish per net-night for channel cross-over bars (Appendix K).

Almost 60% of all the speckled chubs sampled during the sturgeon season were collected on the inside bends (Figure 25) and were most frequently sampled within the channel border mesohabitat (69%) (Figure 26). The majority of speckled chubs collected during the fish community season was sampled on inside bend macrohabitats (65%), followed by channel cross-overs (27%). Almost 78% of the speckled chubs during the fish community season were collected from channel border mesohabitats

A total of 280 speckled chubs were sampled during 2004, with the majority (180 speckled chubs) being sampled during the fish community season. The average fork length was 47.9 mm during the sturgeon season and 42.8 mm during the fish community season (Figure 27). The length range for speckled chubs sampled during the sturgeon season was 30 to 75 mm compared to 20 to 90 mm for the fish community season.

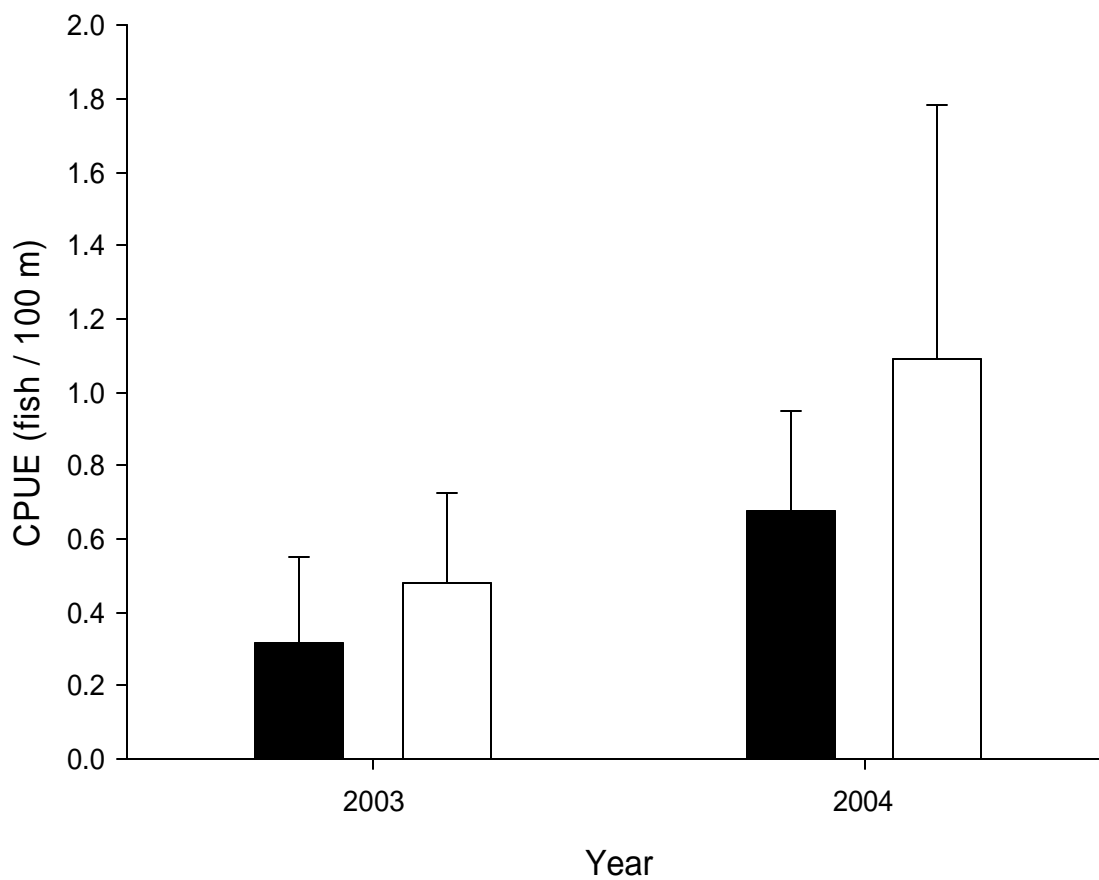


Figure 23. Mean annual catch-per-unit-effort (± 2 SE) of speckled chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River for otter trawling during 2003 and 2004.

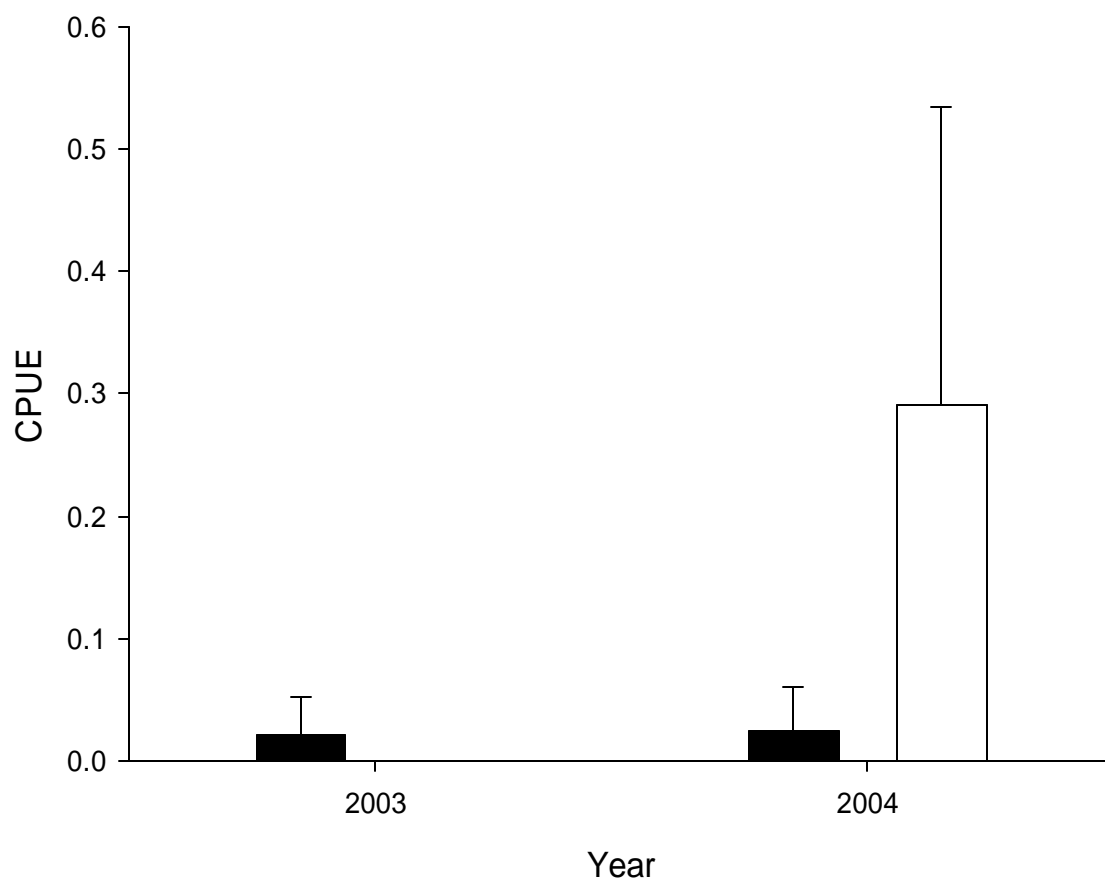


Figure 24. Mean annual catch-per-unit-effort (± 2 SE) of speckled chubs during the fish community season in segment 9 of the Missouri River for seining (black bars) and mini-fyke netting (white bars) during 2003 and 2004.

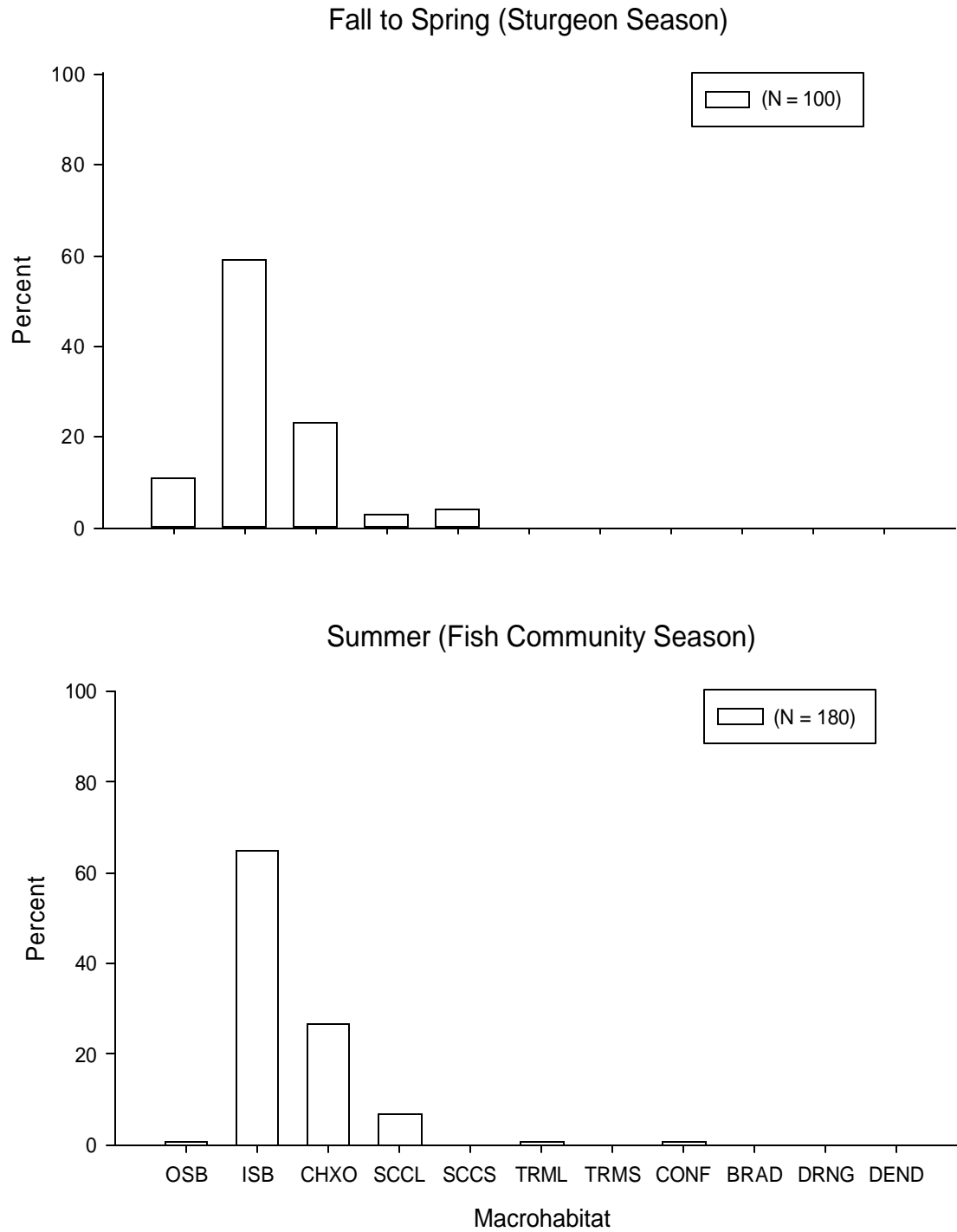


Figure 25. Percent of total speckled chubs caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

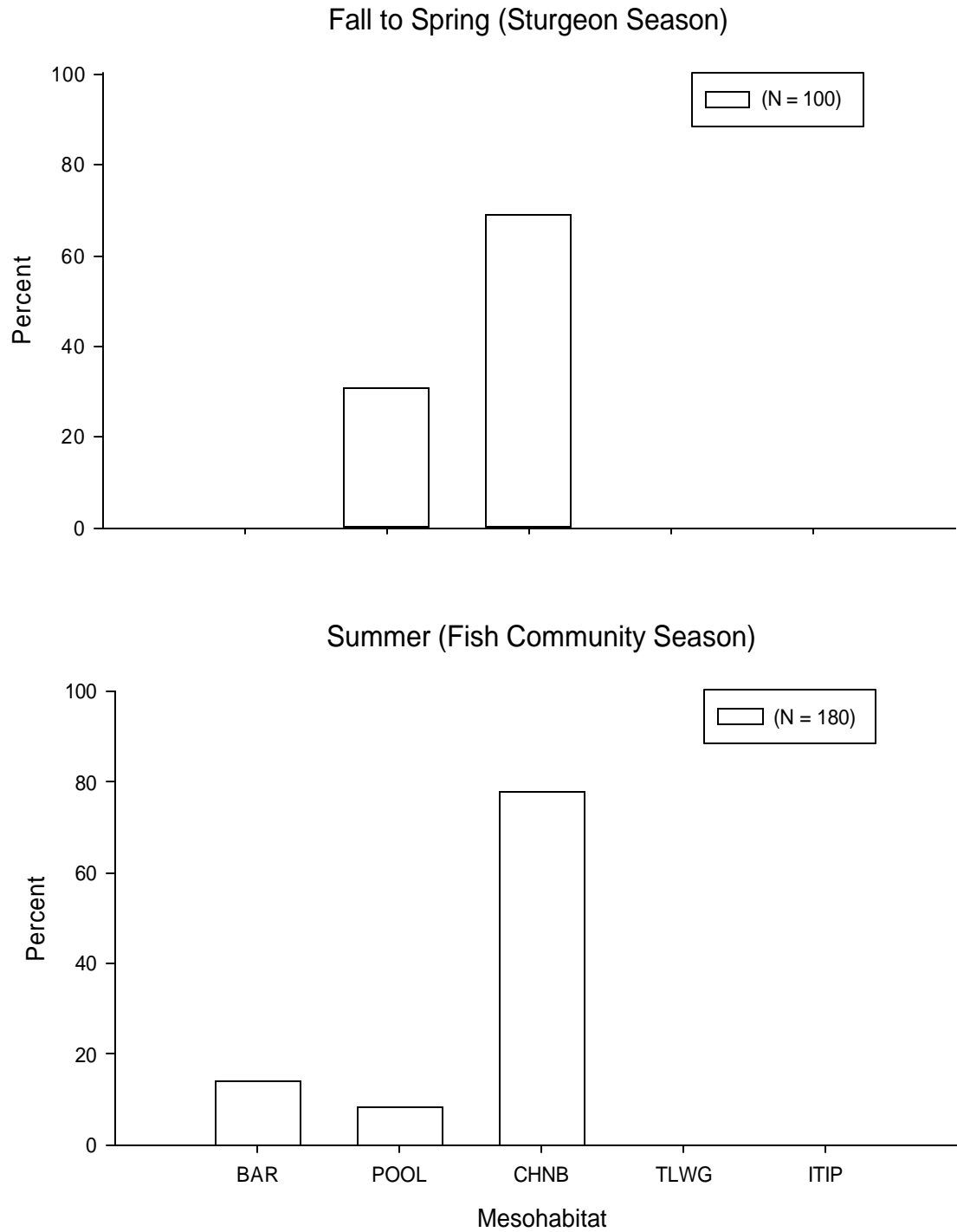


Figure 26. Percent of total speckled chubs caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

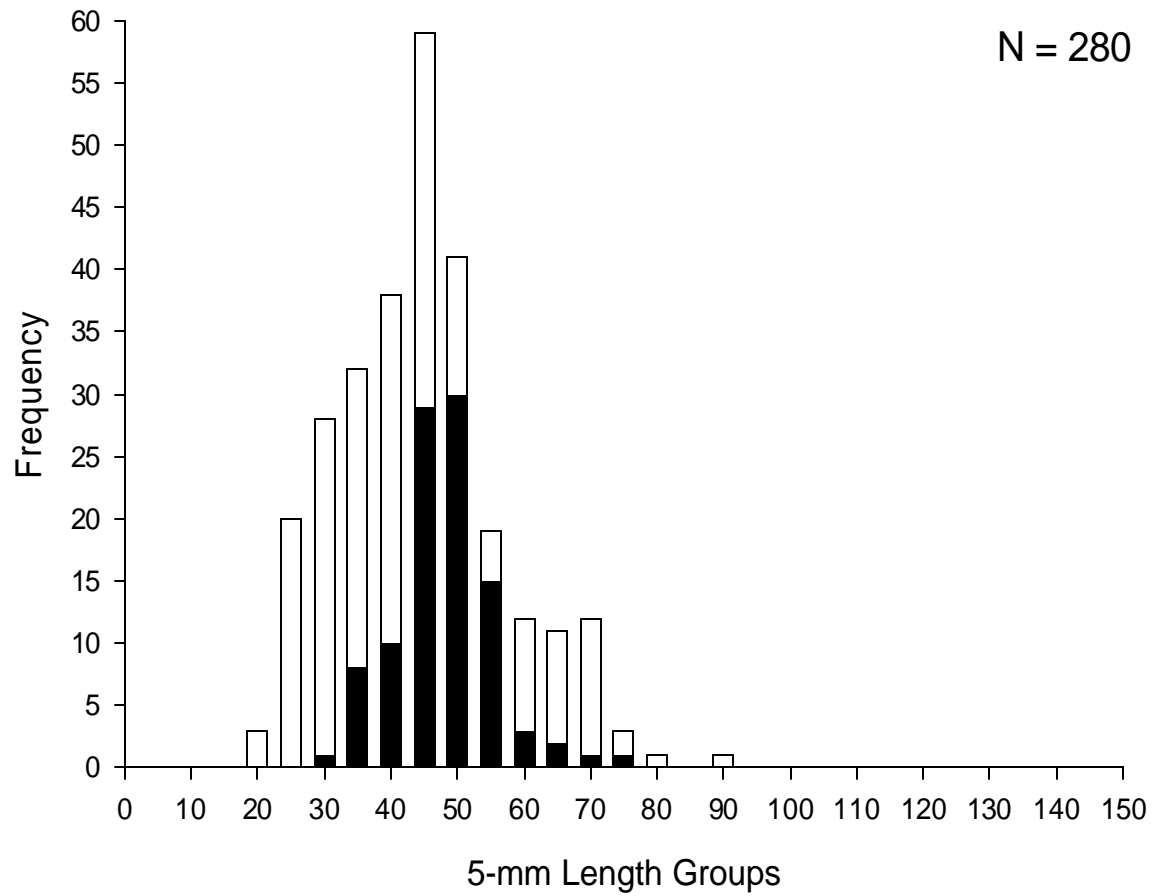


Figure 27. Length frequency of speckled chubs during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Hybognathus spp.

Catch per unit effort for seining for the fish community season declined from 10.8 fish per 100 m² in 2003 to 1.4 fish per 100 m² in 2004 (Figure 29). Mini-fyke nets went from collecting zero fish during 2003 to collecting forty-three plains minnows in the 2004 season. This resulted in a CPUE of 0.5 fish per net-night.

One hundred seventy-eight plains minnows were sampled while seining (Appendix J). Catch per unit effort was similar for outside bend bars (1.9 fish per 100 m²), inside bend bars (1.5 fish per 100 m²) and channel cross-over bars (1.9 fish per 100 m²). Plains minnows were most frequently collected from tributary mouth large bars, with a CPUE of 2.5 fish per net-night and outside bend bars were second (1.0 fish per net-night).

No plains minnows were collected during the sturgeon season (Figure 30). The majority of plains minnows collected during the fish community season were sampled on inside bend macrohabitat (43%) and channel cross-over macrohabitat (41%). Bars were the only mesohabitat sampled where plains minnow were collected (Figure 31).

A total of 222 plains minnows were sampled during 2004, with all being sampled during the fish community season. The average fork length was 44.9 mm (Figure 32). The length range for plains minnows sampled during the fish community season was 26 to 60 mm.

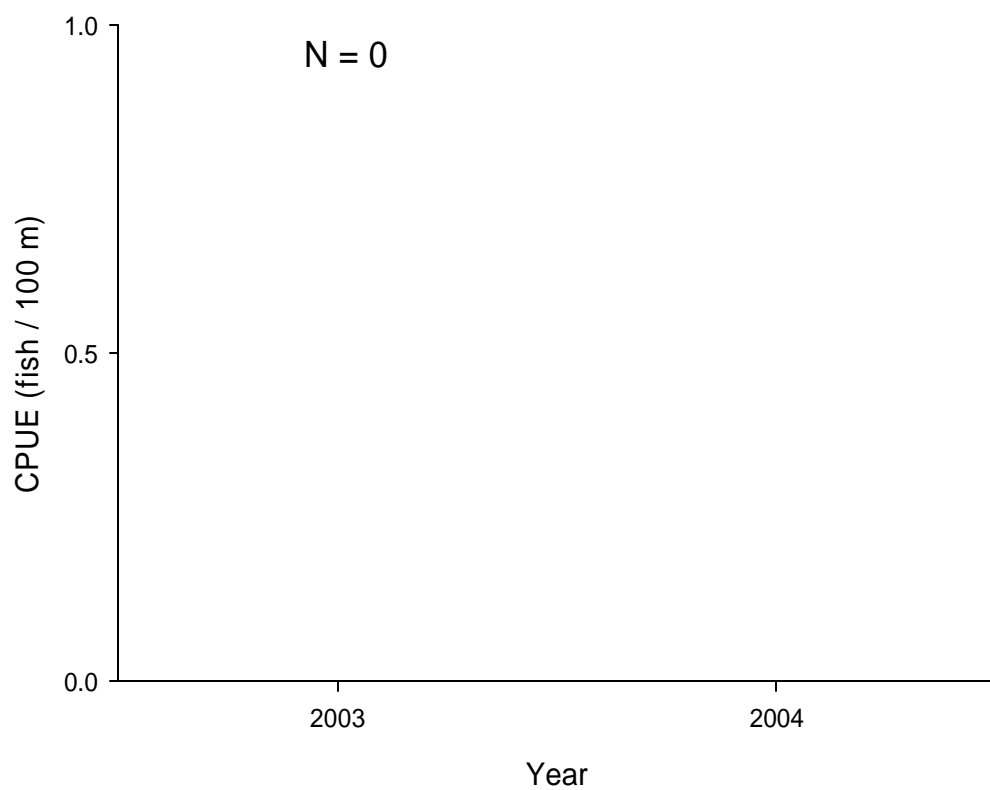


Figure 28. Mean annual catch-per-unit-effort (± 2 SE) of *Hybognathus* spp. during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River for otter trawling during 2003 and 2004.

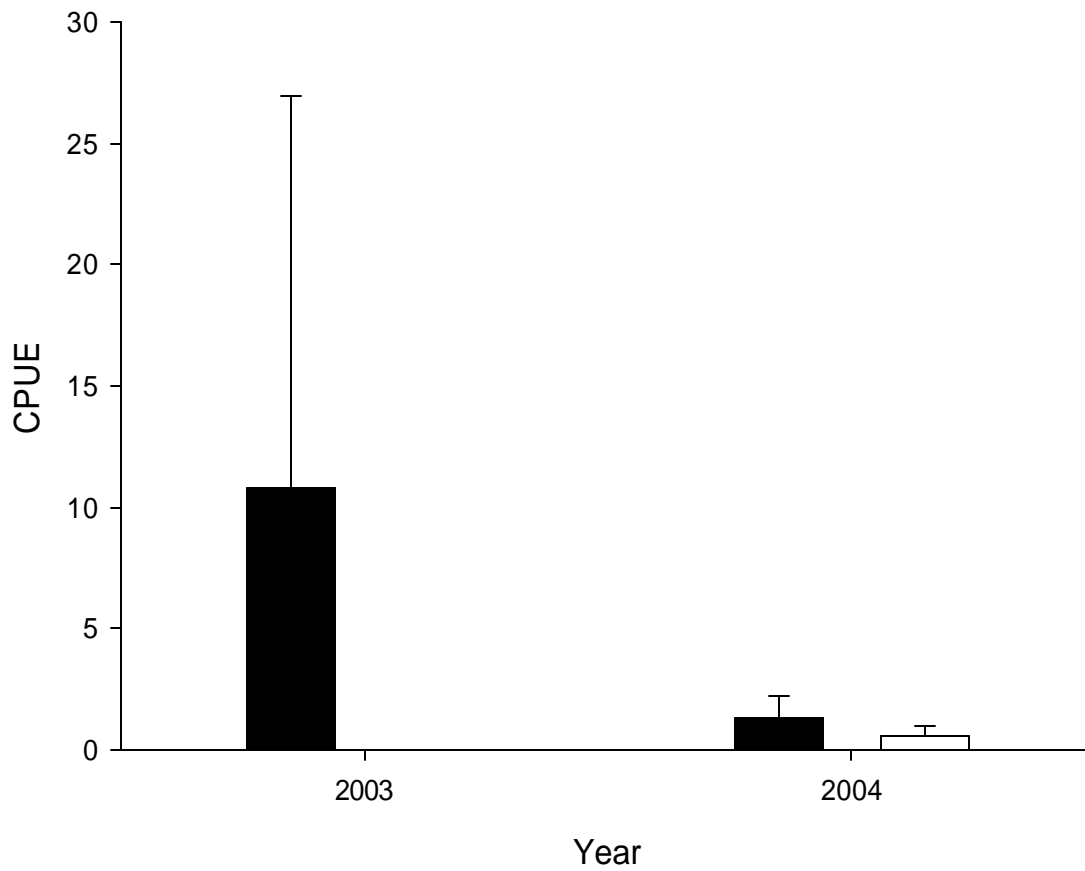


Figure 29. Mean annual catch-per-unit-effort (± 2 SE) of *Hybognathus* spp. during the fish community season in segment 9 of the Missouri River for seining (black bars) and mini-fyke netting (white bars) during 2003 and 2004.

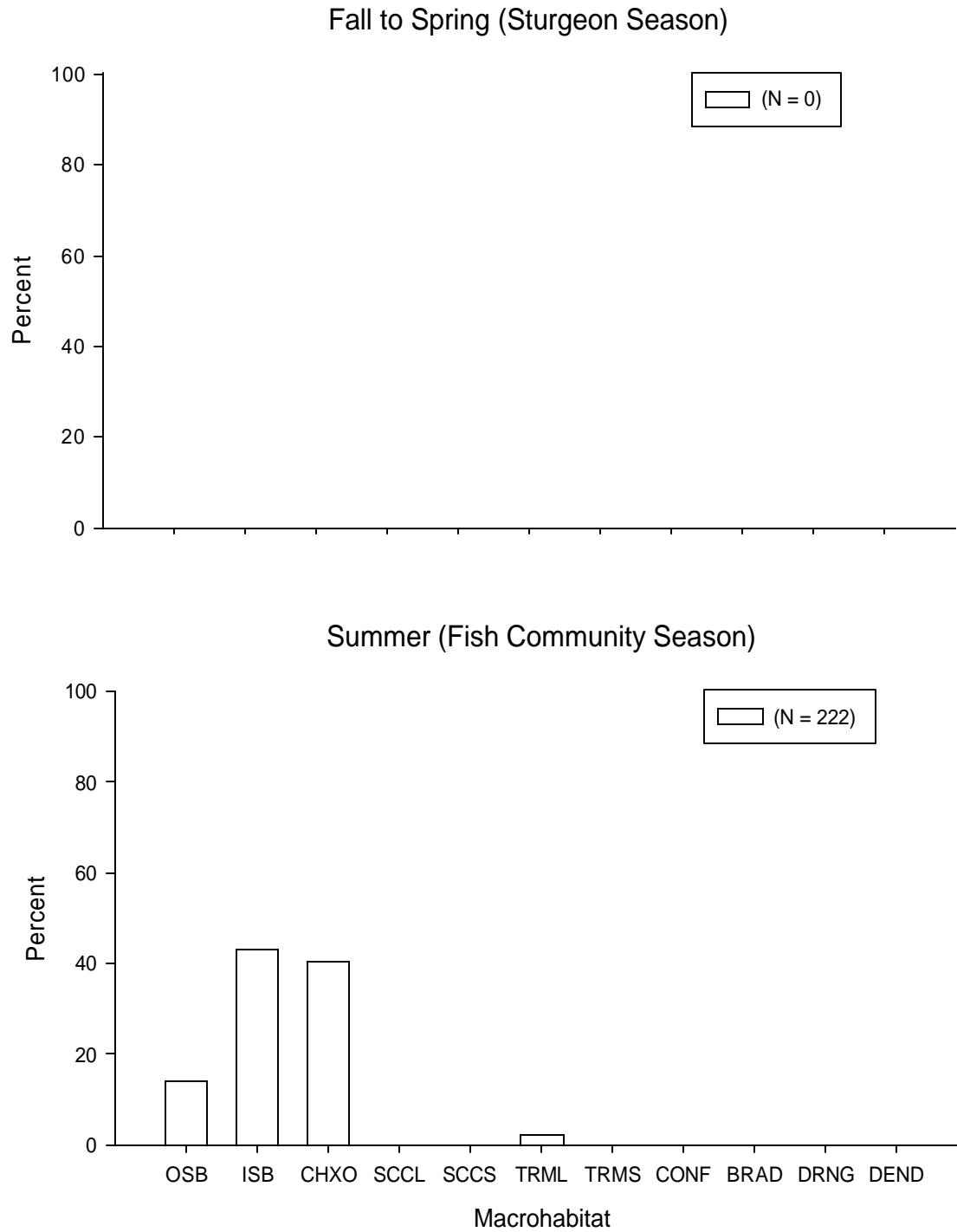


Figure 30. Percent of total *Hybognathus* spp. caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

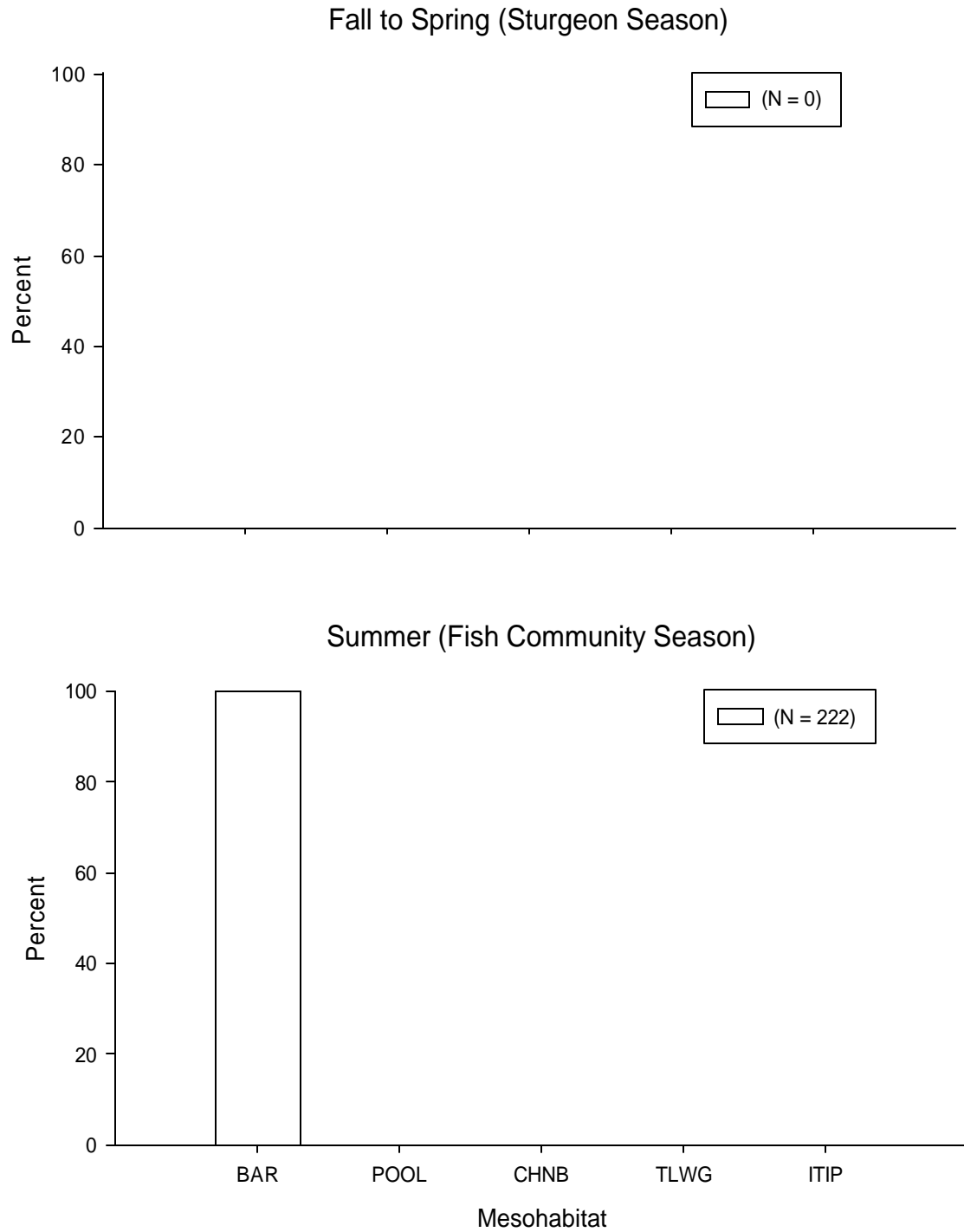


Figure 31. Percent of total *Hybognathus* spp. caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

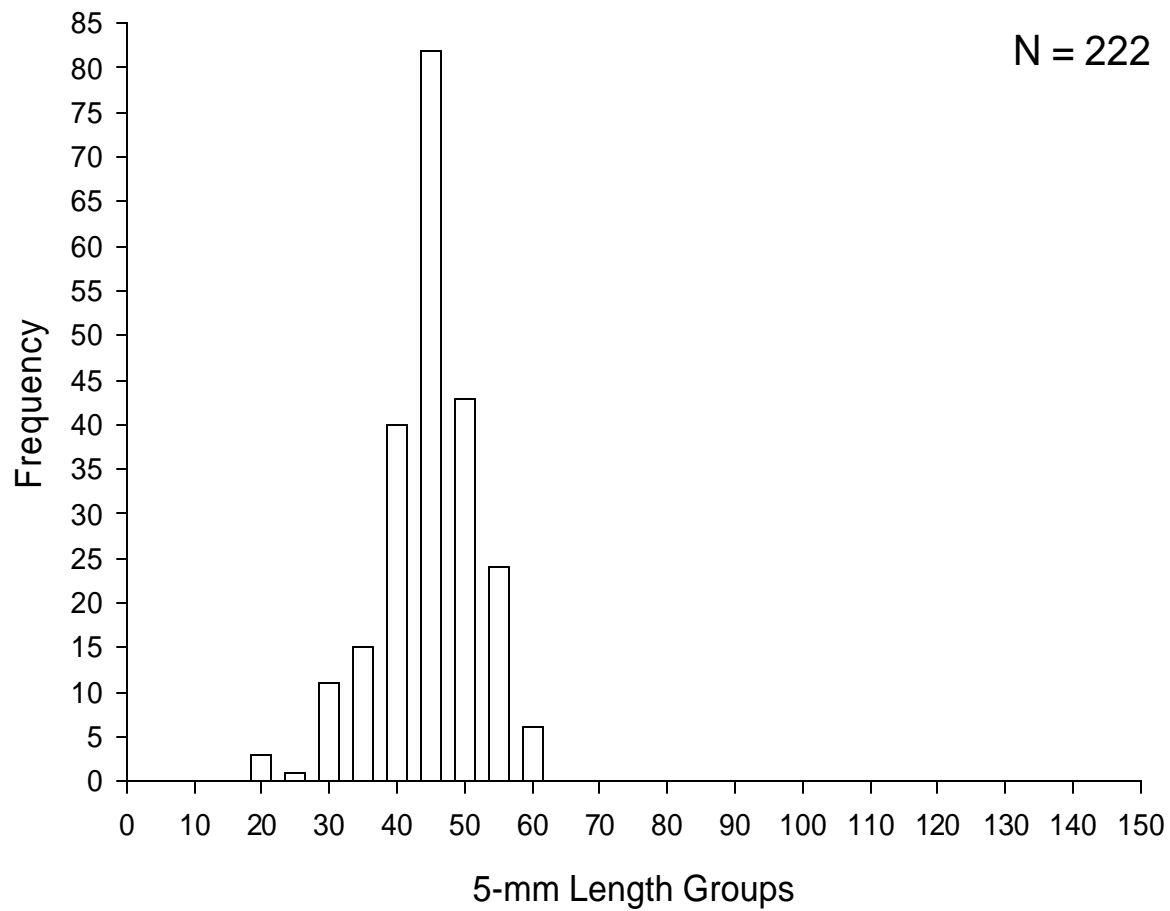


Figure 32. Length frequency of *Hybognathus* spp. during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Sand shiner

Catch per unit effort for otter trawling during the sturgeon season decreased 0.02 fish per 100 m trawled in 2003 to zero in 2004 (Figure 33). Catch per unit effort for otter trawling during the fish community season remained the same with a CPUE of 0.01 fish per 100 m trawled in both 2003 and 2004.

Catch per unit effort for seining during the fish community season declined from 1.16 fish per 100 m² in 2003 to 0.30 fish per 100 m² in 2004 (Figure 34). Catch per unit effort for mini-fyke netting during the fish community season increased from 0.07 fish per net-night in 2003 to 1.51 fish per net-night in 2004.

Two sand shiners were collected during the fish community season using an otter trawl and were both sampled in tributary mouth large channel borders (Appendix H). This resulted in a CPUE of 0.33 fish per 100 m trawled and an overall CPUE of 0.01 fish per 100 m trawled. Thirty-three sand shiners were sampled while seining during the fish community season. Channel cross-overs and confluence bars had similar CPUE of 0.66 fish per 100 m² and 0.63 fish per 100 m², respectively. Sand shiners were also collected on inside bend bars with a CPUE of 0.27 (Appendix J). Mini-fyke nets were the most effective gear at collecting sand shiners, collecting 139. Tributary mouth large had the highest CPUE (3.50 fish per net-night) and channel cross-over bars were second (1.95 fish per net-night) (Appendix K).

All of the sand shiners sampled during the sturgeon season were collected on the inside bend macrohabitats and pool mesohabitats (Figure 35 and 36). The majority of sand shiners collected during the fish community season was sampled on inside bend macrohabitats (48%), followed by channel cross-over mesohabitats (39%). Over 96% of the sand shiners during the fish community season were collected on bar mesohabitats.

A total of 160 sand shiners were sampled during 2004, with the majority (158) being sampled during the fish community season. The average fork length was 43.5 mm during the sturgeon season and 35.2 mm during the fish community season (Figure 37). The length range for sand shiners sampled during the sturgeon season was 43 to 44 mm compared to 23 to 51 mm for the fish community season.

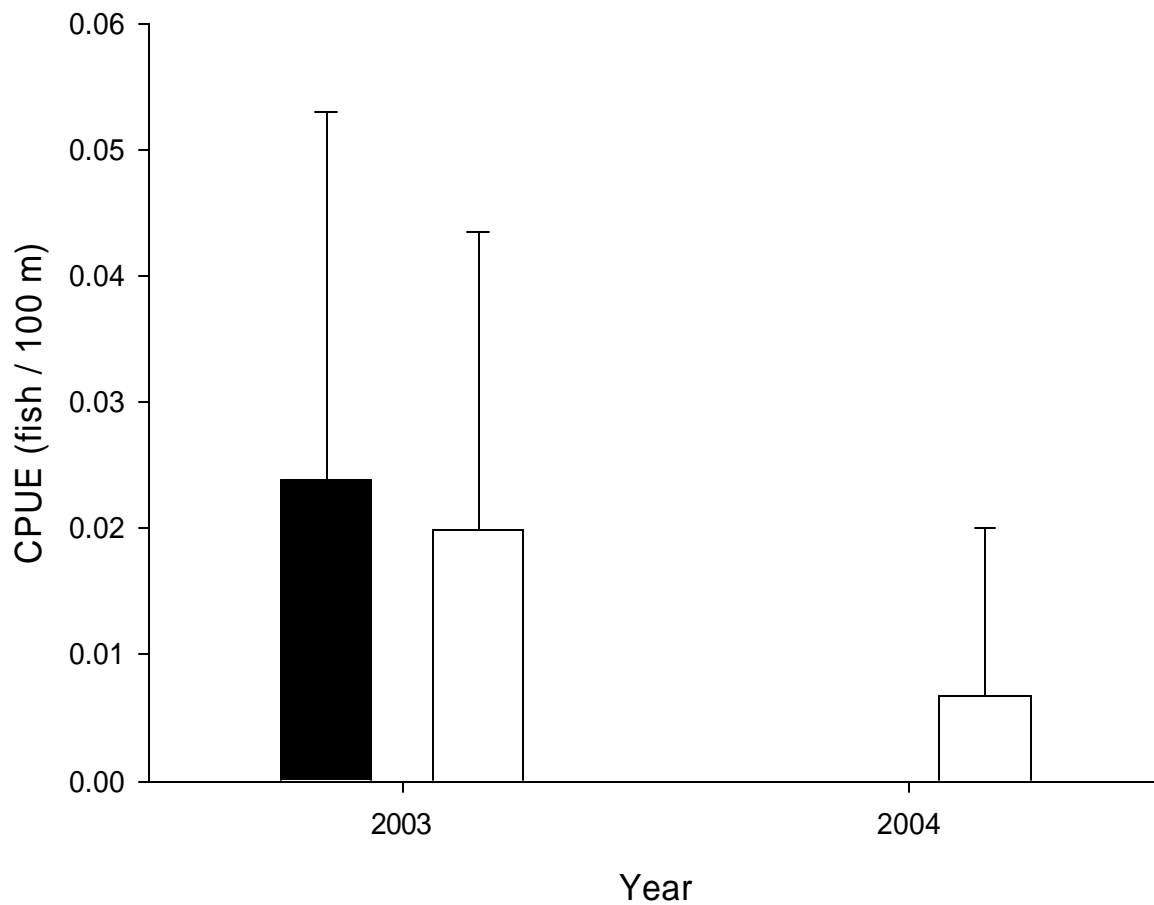


Figure 33. Mean annual catch-per-unit-effort (± 2 SE) of sand shiners during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River for otter trawling during 2003 and 2004.

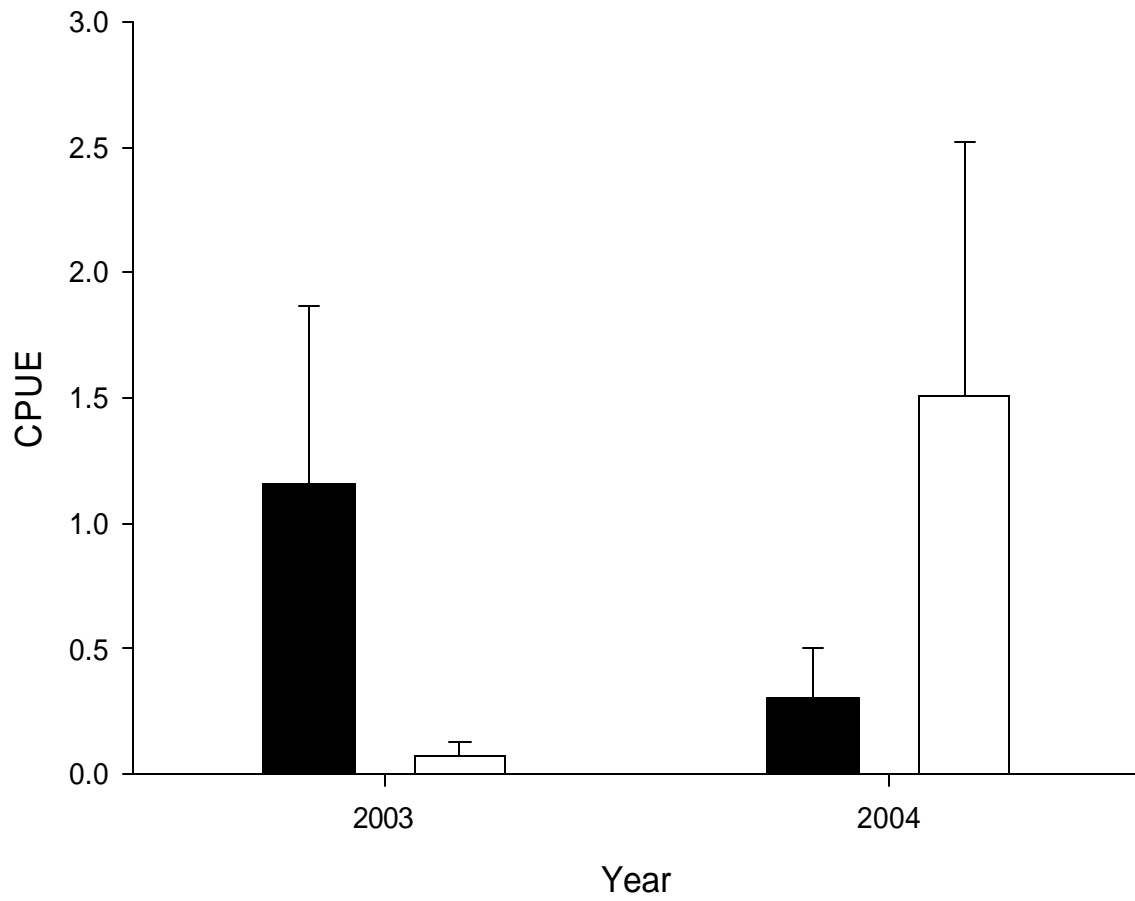


Figure 34. Mean annual catch-per-unit-effort (± 2 SE) of shiner sands during the fish community season in segment 9 of the Missouri River for seining (black bars) and mini-fyke netting (white bars) during 2003 and 2004.

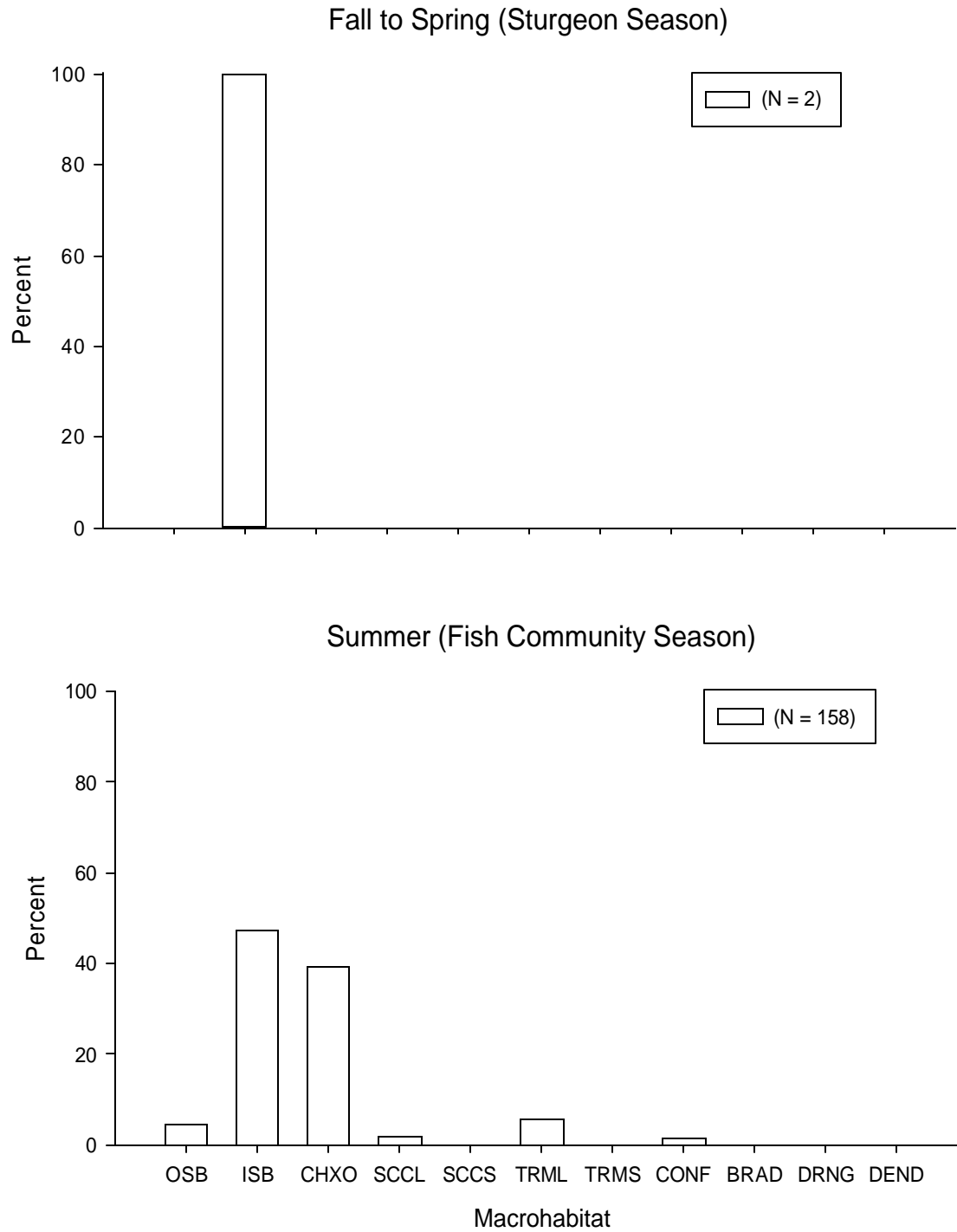


Figure 35. Percent of total sand shiners caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

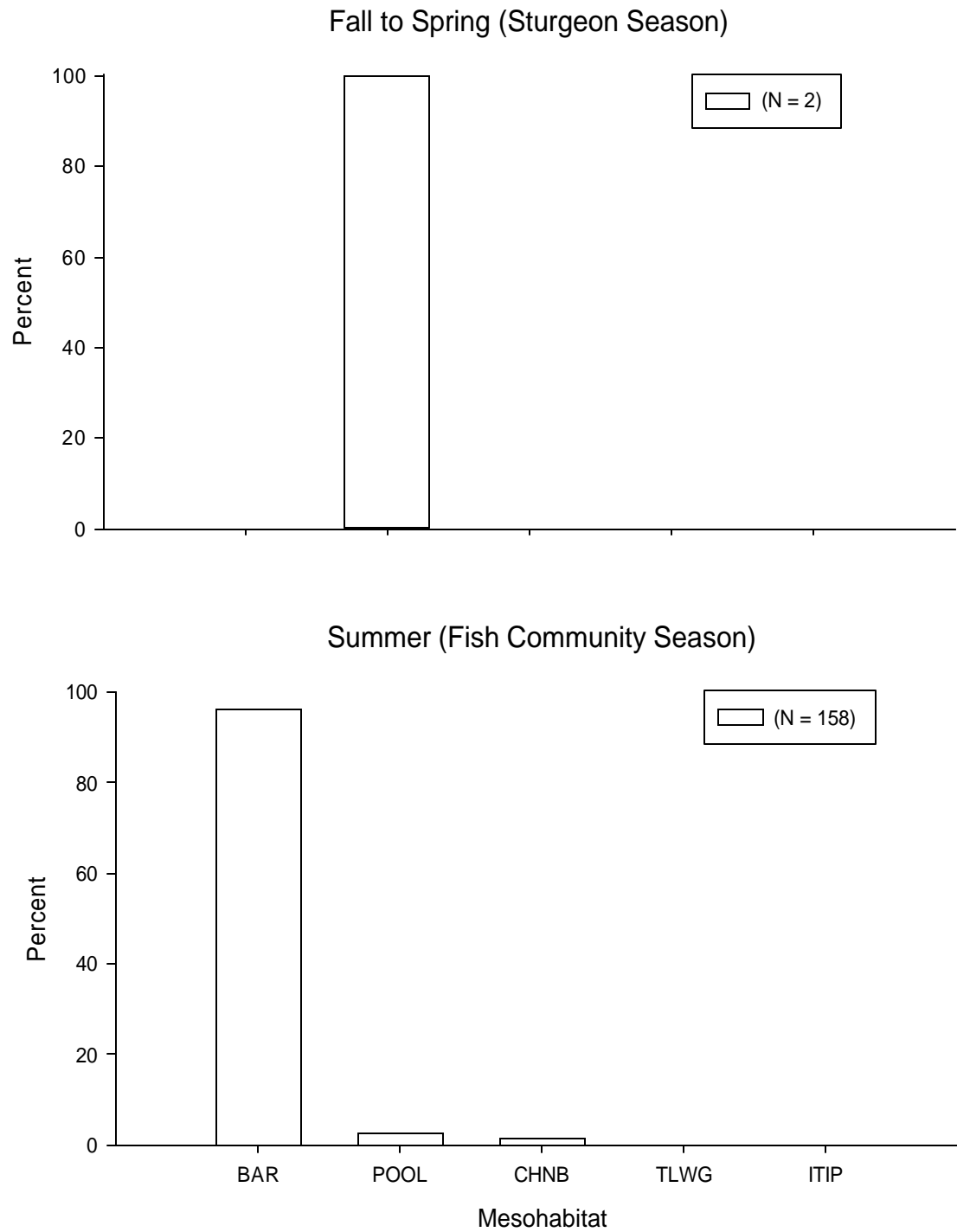


Figure 36. Percent of total sand shiners caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

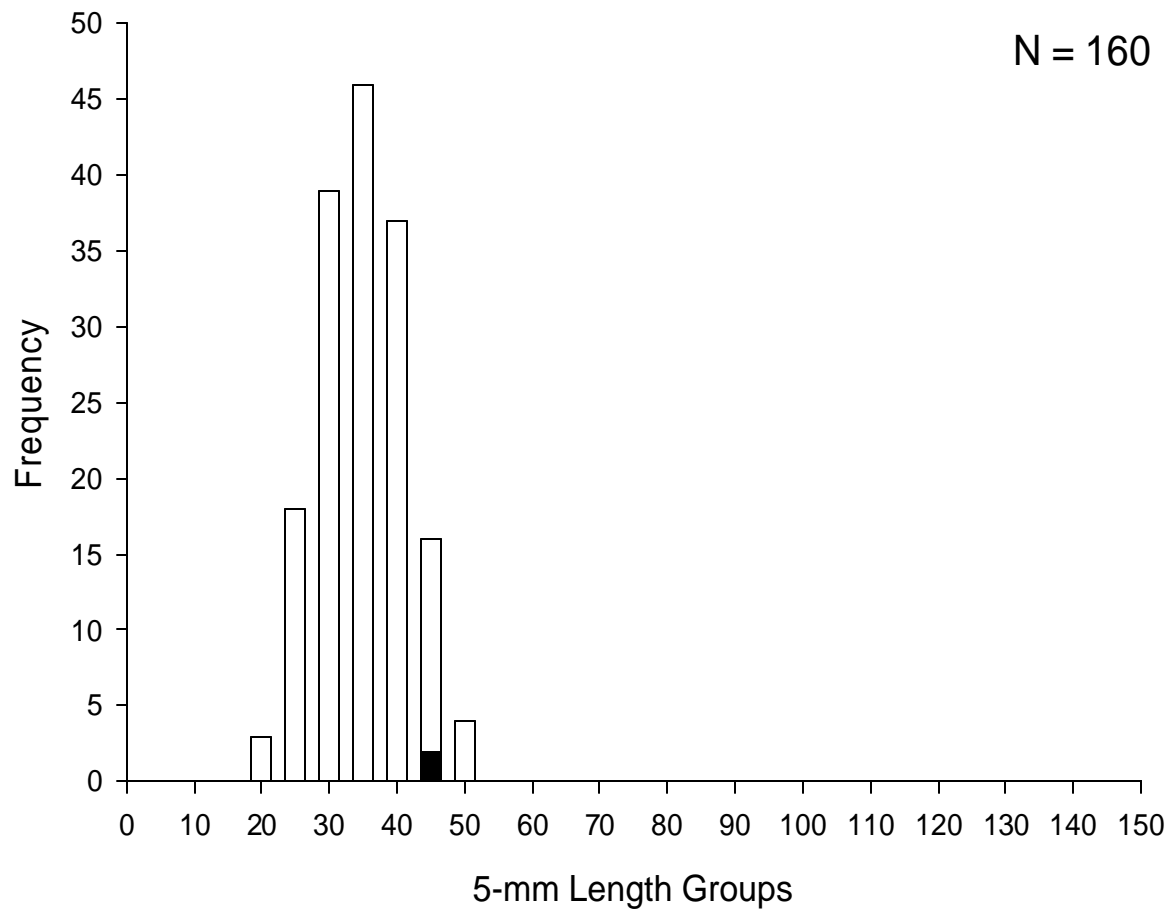


Figure 37. Length frequency of sand shiners during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Native catostomids

Bigmouth buffalo

Catch per unit effort for gill netting during the sturgeon season for bigmouth buffalo remained similar at 0.005 fish per net-night in 2003 to 0.003 fish per net-night in 2004 (Figure 38). Catch per unit effort for trammel netting during the sturgeon season increased from 0.01 fish per 100 m drifted in 2003 to 0.02 fish per 100 m drifted in 2004. No bigmouth buffalo were sampled during the past two years while otter trawling during the sturgeon season.

Catch per unit effort for trammel netting during the fish community season increased from zero in 2003 to 0.01 fish per 100 m drifted in 2004 (Figure 39). No bigmouth buffalo were sampled during the past two years while otter trawling during the fish community season.

Catch per unit effort for seining during the fish community season decreased from 0.03 fish per 100 m² to 0.01 fish per 100 m² in 2004 (Figure 40). No bigmouth buffalo were sampled during the past two years while mini-fyke netting during the fish community season.

Only one bigmouth buffalo was sampled during the sturgeon season while gill netting (Appendix E). It was collected in a confluence pool, with a CPUE of 0.13 fish per net-night. Only two bigmouth buffalo were sampled during the sturgeon season while drifting trammel nets (Appendix G). Both fish were collected in the channel cross-over channel borders, with a CPUE of 0.10 fish per 100 m drifted. Only one bigmouth buffalo was sampled during the fish community season while drifting trammel nets (Appendix I). It was collected in the channel cross-over channel border, with a CPUE of 0.06 fish per 100 m drifted. Only one bigmouth buffalo was sampled using a bag seine during the fish community season (Appendix J). It was sampled on an inside bend bar, with a CPUE of 0.02 fish per 100 m².

Three of the four bigmouth buffalo sampled during the sturgeon season were collected from the channel cross-over (Figure 41). Pools and channel borders were the only mesohabitats where bigmouth buffalo were collected during the sturgeon season (Figure 42). Two of the three bigmouth buffalo sampled during the fish community season were collected from the inside bends. Channel borders and bars were the only mesohabitats where bigmouth buffalo were collected during the fish community season.

A total of 7 bigmouth buffalo were sampled during 2004, with 4 being sampled during the sturgeon season. The average fork length was 512.7 mm and the median was 576 mm (Figure 43). The length range for bigmouth buffalo was 50 to 698 mm.

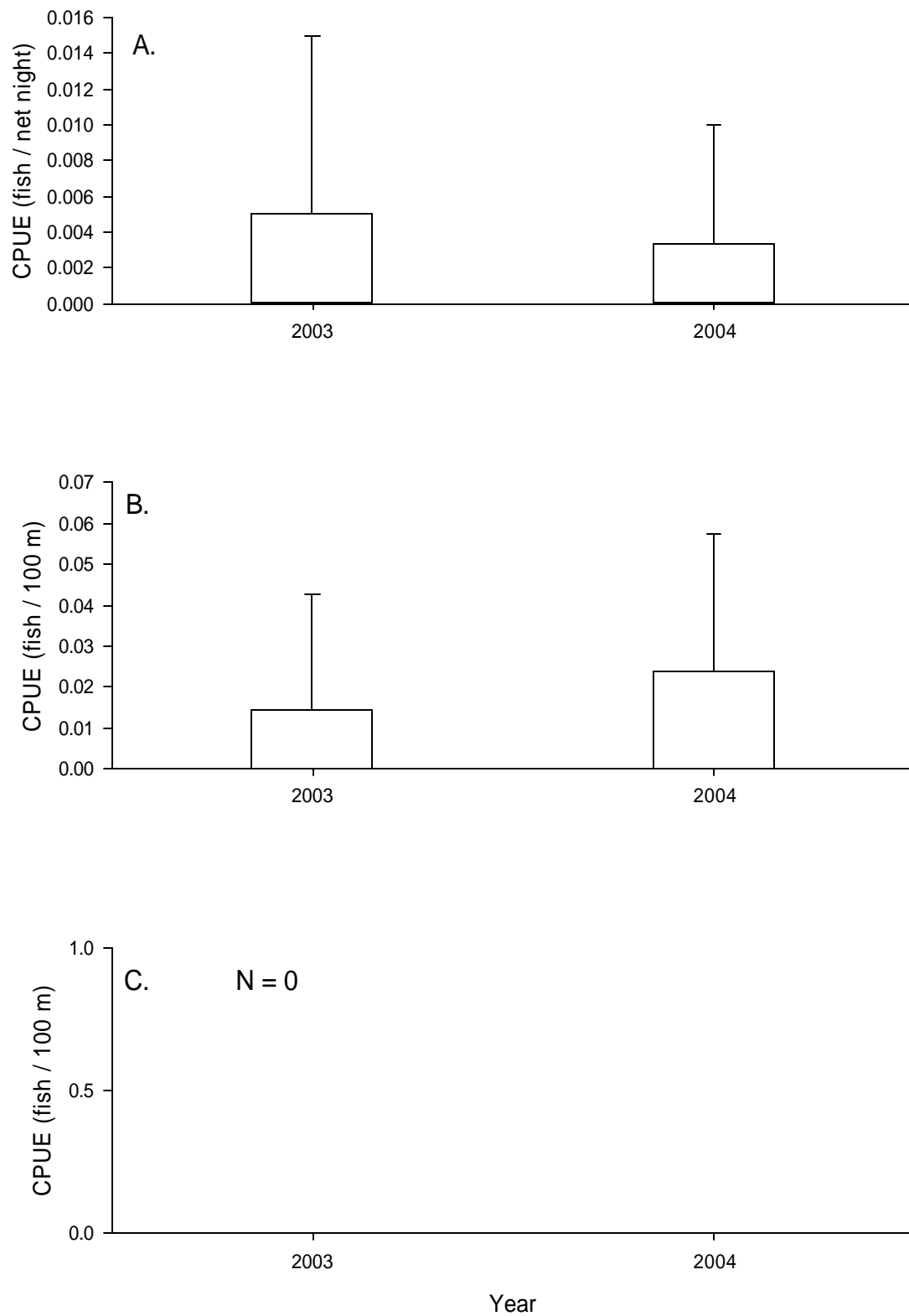


Figure 38. Mean annual catch-per-unit-effort (± 2 SE) of bigmouth buffalo in segment 9 of the Missouri River for: A) gill nets, B) trammel nets and C) otter trawls during the sturgeon season during 2003 and 2004.

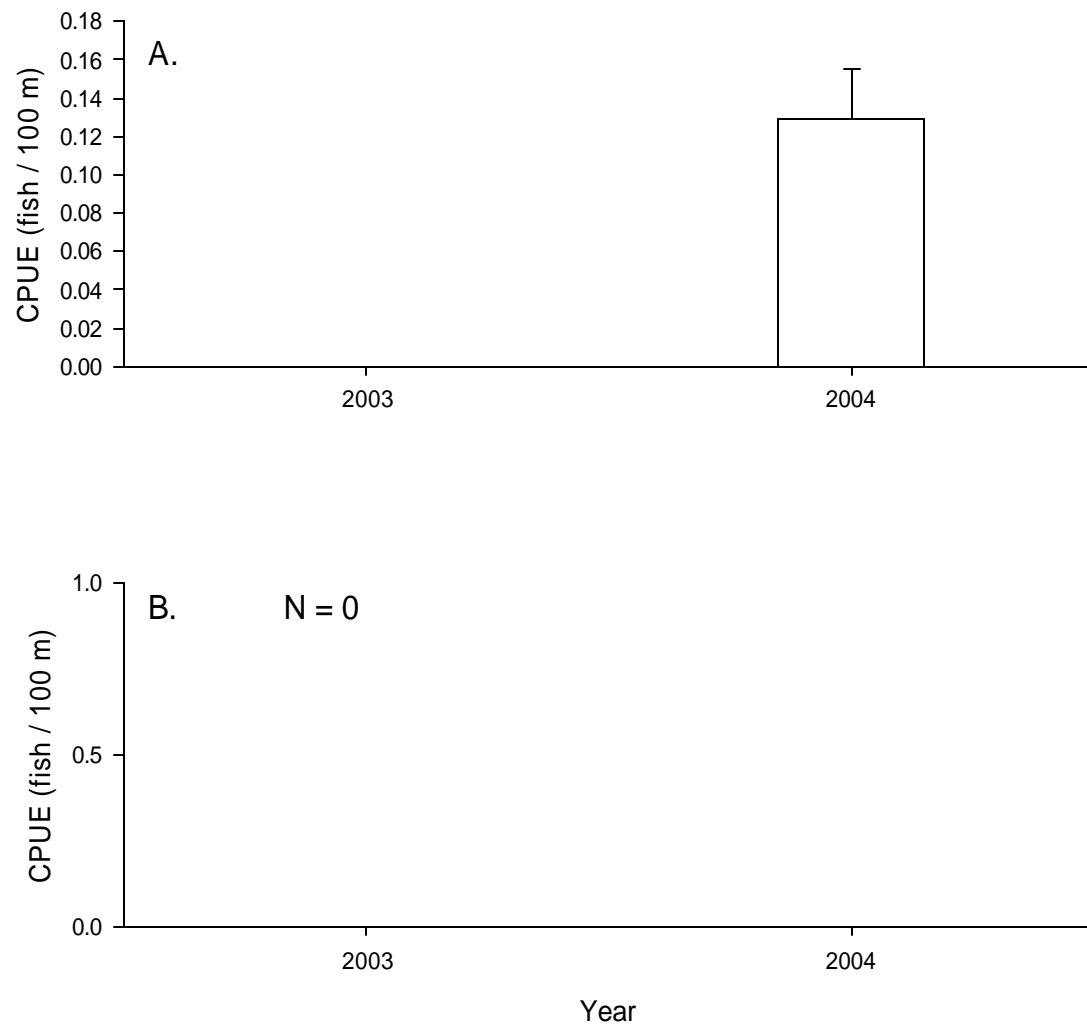


Figure 39. Mean annual catch-per-unit-effort (± 2 SE) of bigmouth buffalo in segment 9 of the Missouri River for: A) trammel nets and B) otter trawls during the fish community season during 2003 and 2004.

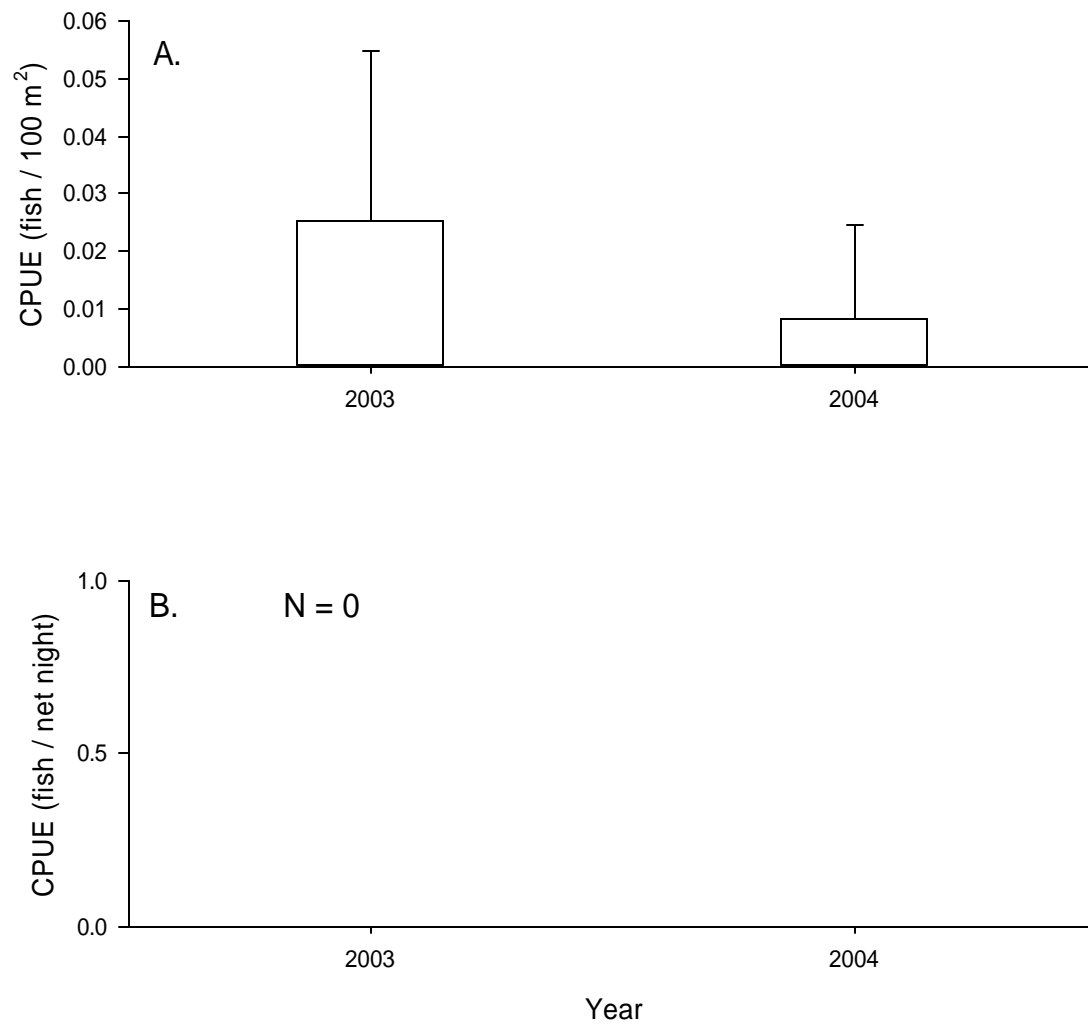


Figure 40. Mean annual catch-per-unit-effort (\pm 2 SE) of bigmouth buffalo in segment 9 of the Missouri River for: A) seining and B) mini-fyke nets during the fish community season during 2003 and 2004.

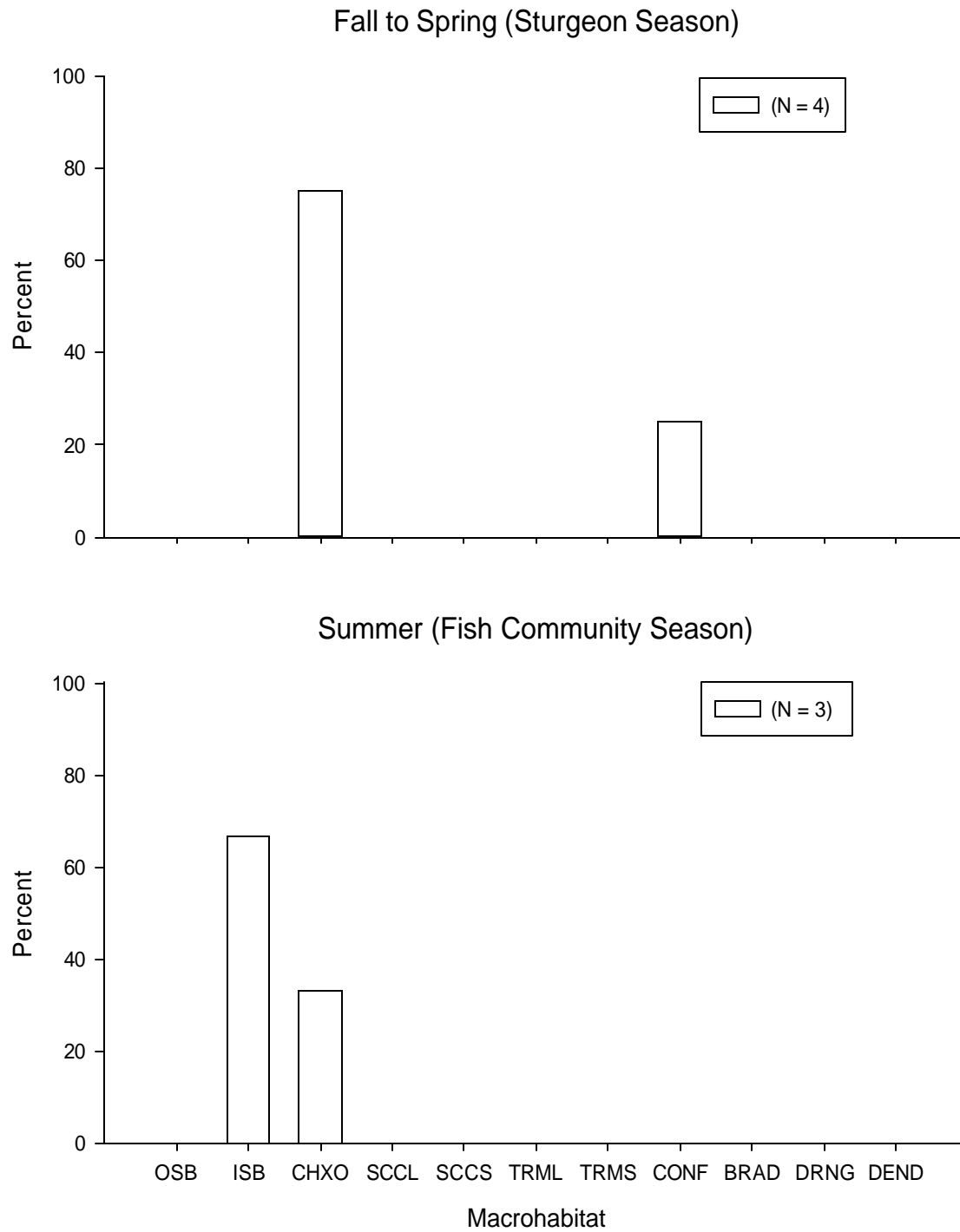


Figure 41. Percent of total bigmouth buffalo caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

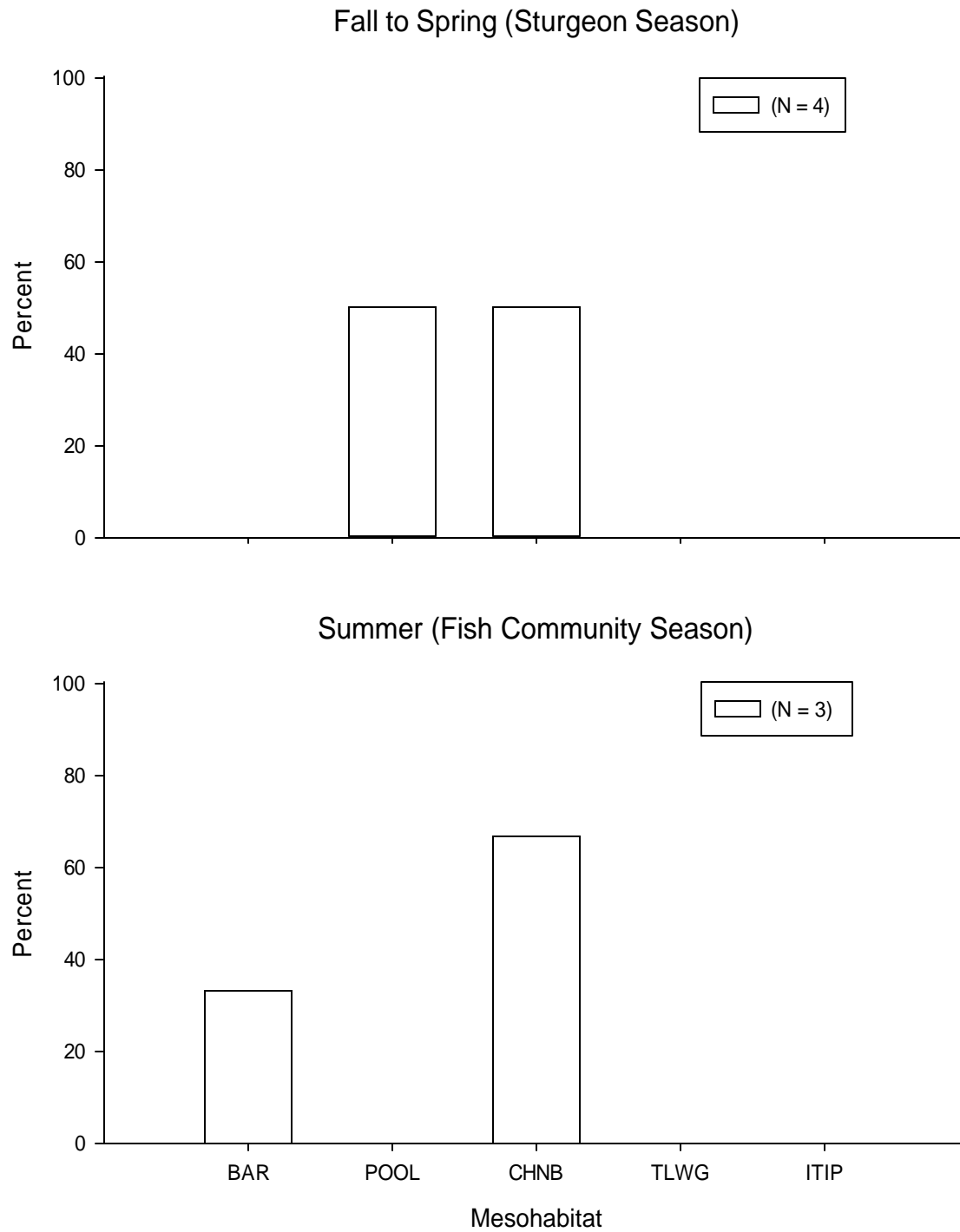


Figure 42. Percent of total bigmouth buffalo caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

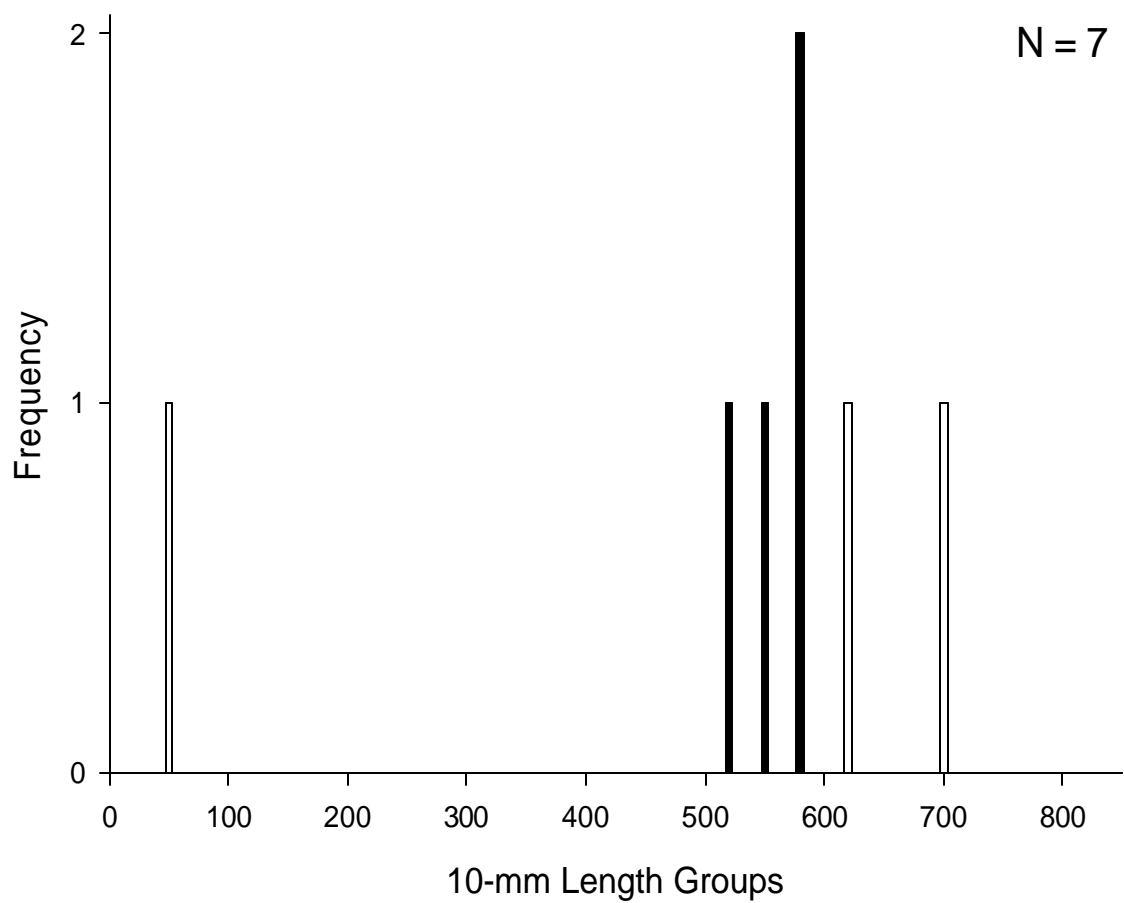


Figure 43. Length frequency of bigmouth buffalo during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Blue sucker

Catch per unit effort for gill netting during the sturgeon season increased from 0.1 fish per net-night in 2003 to 0.5 fish per net-night in 2004 (Figure 44). Catch per unit effort for trammel netting during the sturgeon season remained relatively constant with a CPUE of 0.2 fish per 100 m drifted in 2003 compared to 0.2 fish per 100 m drifted in 2004. Catch per unit effort for otter trawling during the sturgeon season declined from 0.10 fish per 100 m trawled in 2003 to 0.05 fish per 100 m trawled in 2004.

Catch per unit effort for trammel netting during the fish community season declined from 1.2 fish per 100 m drifted in 2003 to 0.8 fish per 100 m drifted in 2004 (Figure 45). Catch per unit effort for otter trawling during the fish community season increase from 0.10 fish per 100 m trawled in 2003 to 0.16 fish per 100 m trawled in 2004. No blue suckers were sampled while seining or mini-fyke netting during the past two years (Figure 46).

One hundred and fifty blue suckers were sampled during the sturgeon season while gill netting (Appendix E). Channel cross-over pools had the highest CPUE (0.9 fish per net-night) and inside bend pools were second (0.6 fish per net-night). Inside bend channel borders had the highest CPUE (0.08 fish per 100 m trawled) for otter trawling during the sturgeon season (Appendix F). Twenty-one blue suckers were sampled during the sturgeon season while drifting trammel nets (Appendix G). Channel cross-over channel borders had the highest CPUE (0.4 fish per 100 m drifted). Twenty blue suckers were sampled during the fish community season using an otter trawl (Appendix H). Confluence channel borders had the highest CPUE (0.67 fish per 100 m trawled) and channel cross-over channel borders had the lowest (0.09 fish per 100 m trawled). Eighty-eight blue suckers were sampled during the fish community season while drifting trammel nets (Appendix I). Secondary channel connect large channel borders had the

highest CPUE (1.88 fish per 100 m drifted) and inside bend channel borders were second (0.94 fish per 100 m drifted).

Blue suckers were most frequently sampled during the sturgeon season from inside bend macrohabitat (65%) (Figure 47) and the pool mesohabitat (62%) (Figure 48). In the fish community season, blue suckers were again most frequently sampled on the inside bend macrohabitat (69%) and the channel border mesohabitat was the only mesohabitat where blue suckers were collected.

A total of 447 blue suckers were sampled during 2004, with 253 being sampled during the fish community season. The average fork length was 667.5 mm (median = 682 mm) during the sturgeon season compared to 652.1 mm (median = 654 mm) for the fish community season (Figure 49). The length range for blue suckers sampled during the sturgeon season was 402 to 823 mm compared to 266 to 888 mm for the fish community season.

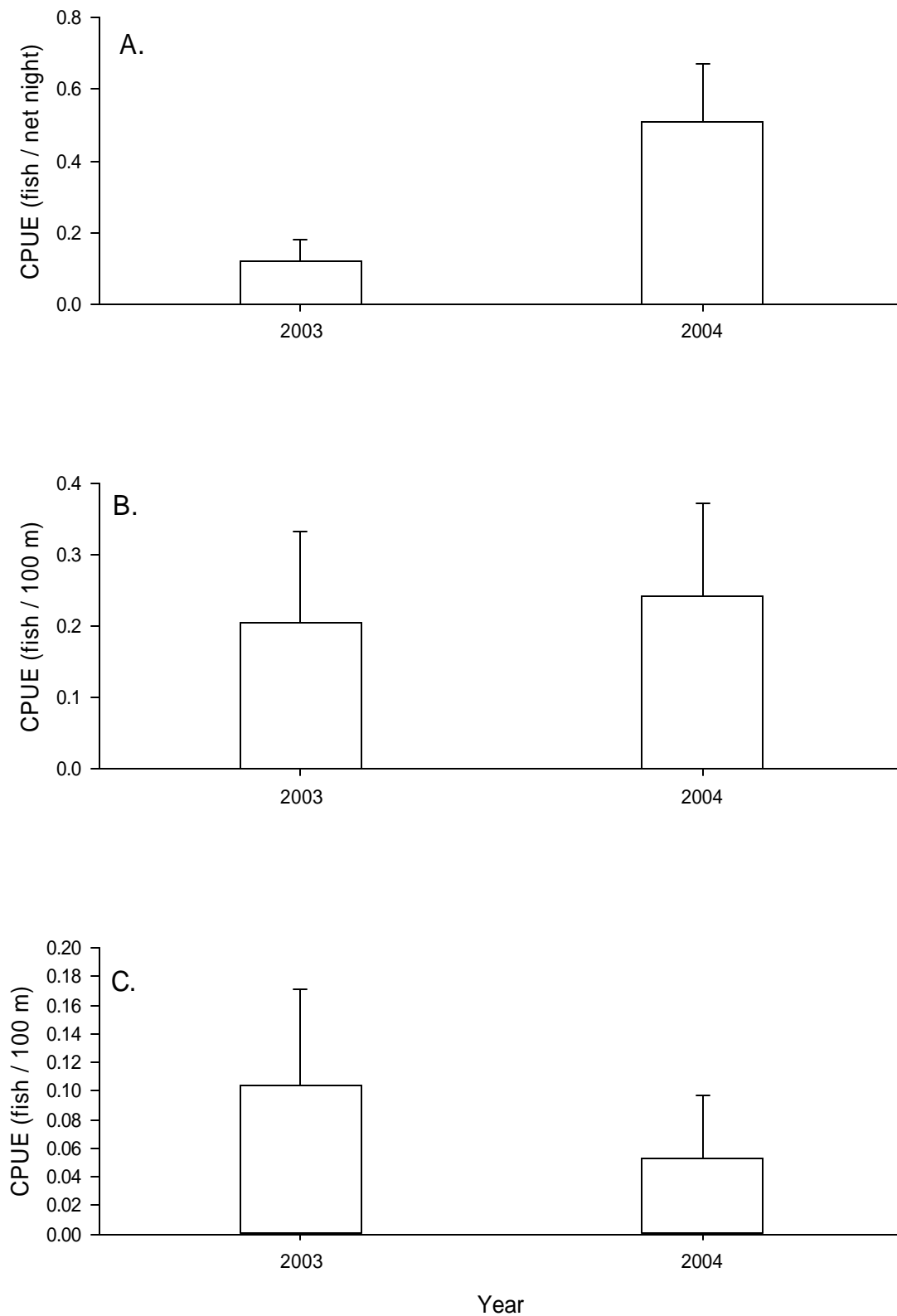


Figure 44. Mean annual catch-per-unit-effort (± 2 SE) of blue suckers in segment 9 of the Missouri River for: A) gill nets, B) trammel nets and C) otter trawls during the sturgeon season during 2003 and 2004.

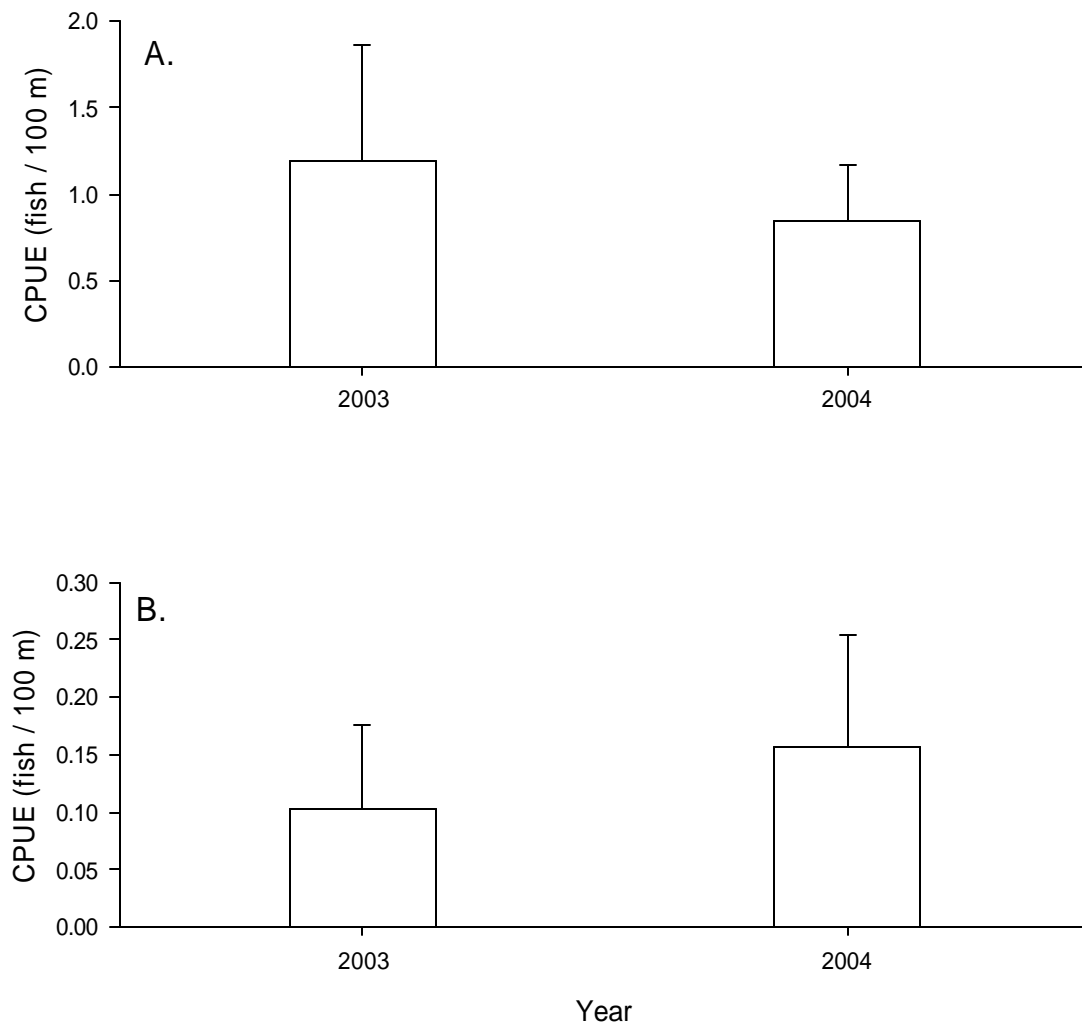


Figure 45. Mean annual catch-per-unit-effort (± 2 SE) of blue suckers in segment 9 of the Missouri River for: A) trammel nets and B) otter trawls during the fish community season during 2003 and 2004.

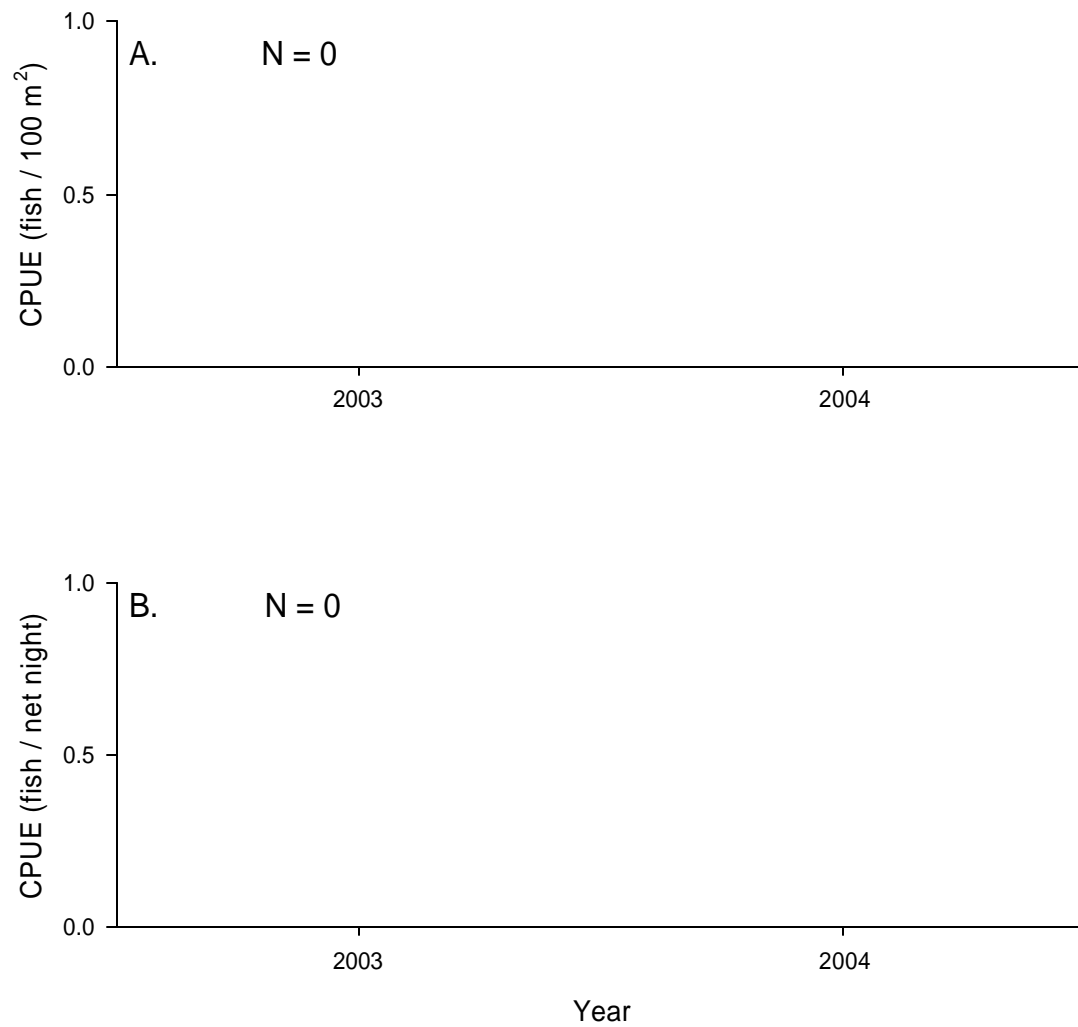


Figure 46. Mean annual catch-per-unit-effort (\pm 2 SE) of blue suckers in segment 9 of the Missouri River for: A) seining and B) mini-fyke nets during the fish community season during 2003 and 2004.

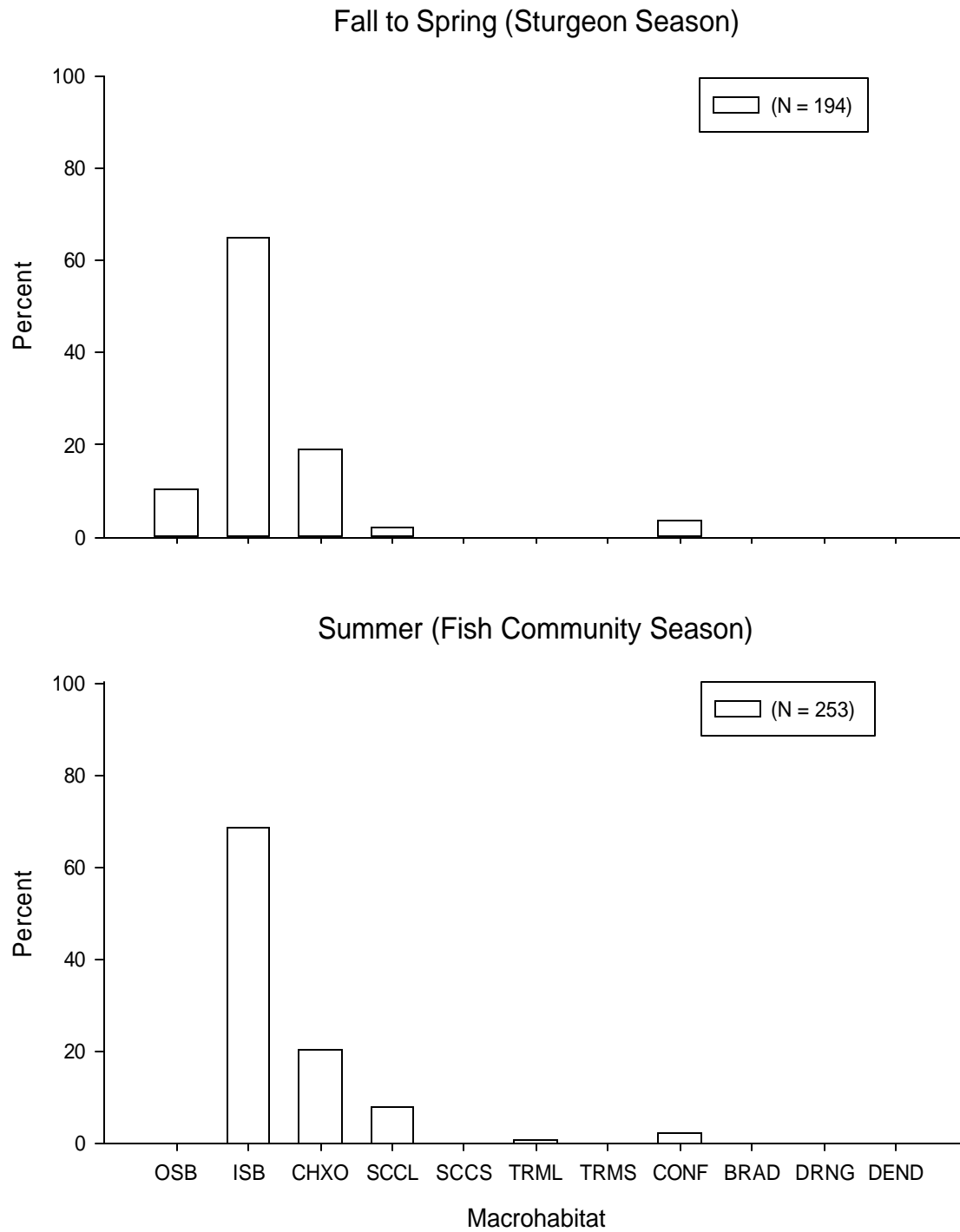


Figure 47. Percent of total blue suckers caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

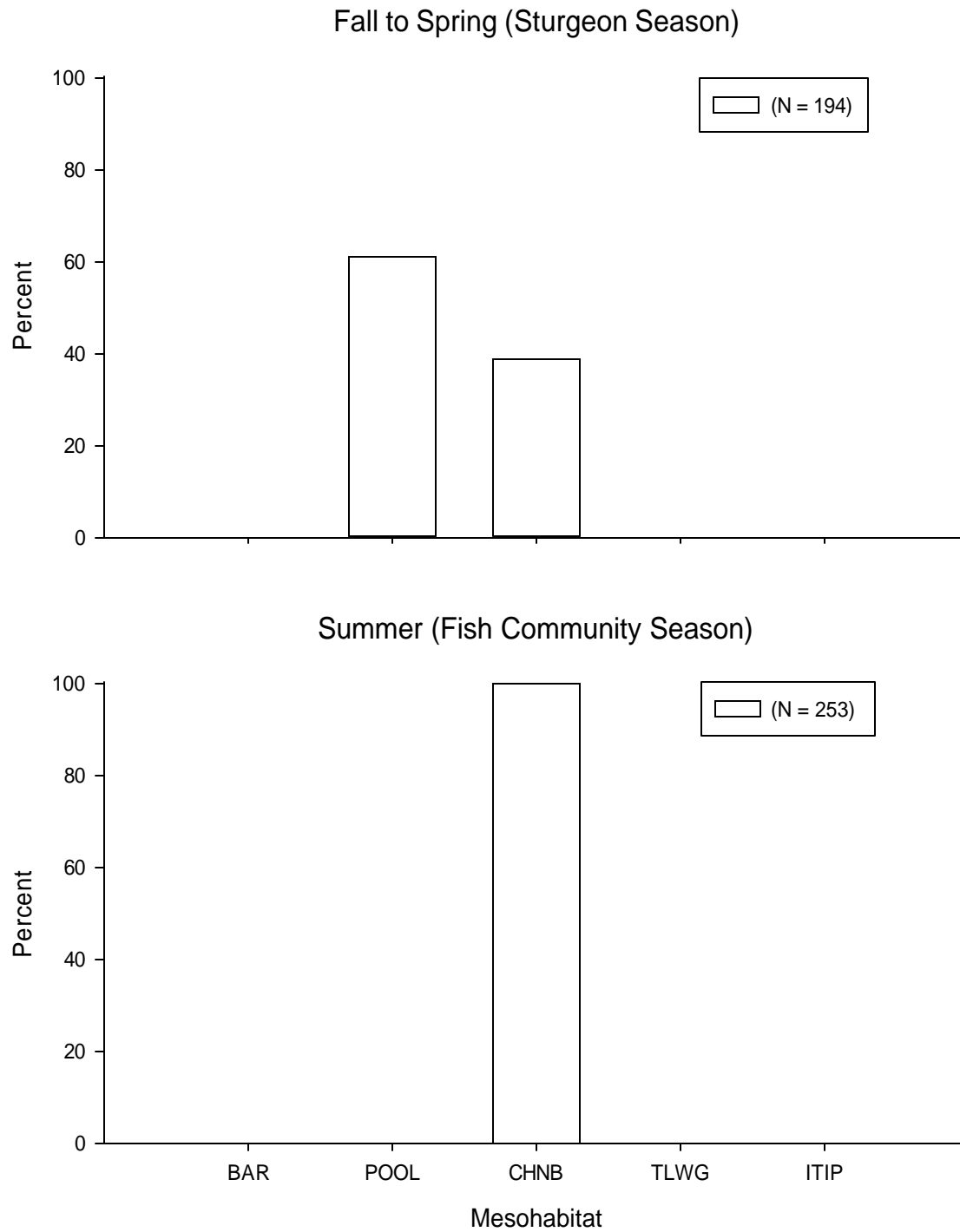


Figure 48. Percent of total blue suckers caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

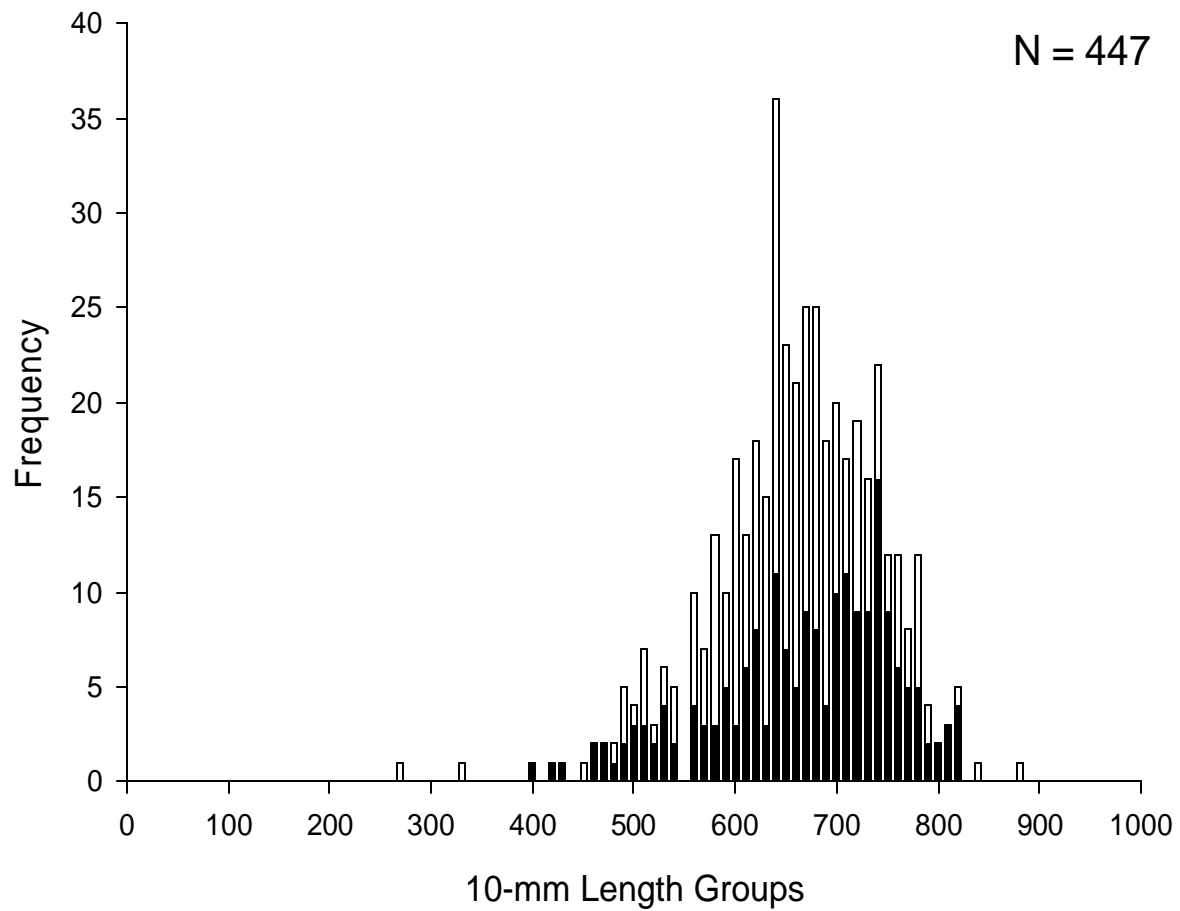


Figure 49. Length frequency of blue suckers during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

Native Percids

Sauger

Catch per unit effort for gill netting during the sturgeon season increased from 0.03 fish per net-night in 2003 to 0.11 fish per net-night in 2004 (Figure 50). Catch per unit effort for trammel netting during the sturgeon season decreased from 0.03 fish per 100 m drifted in 2003 to < 0.01 fish per 100 m drifted in 2004. No sauger were collected while otter trawling during the sturgeon season for the first two years of this project.

No sauger were collected while trammel netting during the fish community season for the first two years of this project. Catch per unit effort for otter trawling during the fish community season increase from zero in 2003 to < 0.01 fish per 100 m trawled in 2004 (Figure 51). No sauger were collected while seining or mini-fyke netting during the 2004 season compared to nine that were collected in 2003 (Figure 52).

Thirty-two sauger were sampled during the sturgeon season while gill netting (Appendix E). Channel cross-over pools had the highest CPUE (0.39 fish per net-night) and outside bend channel borders were second (0.25 fish per net-night). The only sauger sampled during the sturgeon season while drifting trammel nets was collected from the confluence channel border, with a CPUE of 0.17 fish per 100 m drifted (Appendix G). The only sauger sampled during the fish community season using an otter trawl was collected from a tributary mouth large channel border, with a CPUE of 0.17 fish per 100 m trawled.

Sauger were most frequently sampled during the sturgeon season from inside bend macrohabitat (49%) (Figure 53) and pool mesohabitat (80%) (Figure 54). During the fish community season, two sauger were collected; one from an inside bend and the other from a tributary mouth large, and both were collected from the channel border.

A total of 35 sauger were sampled during 2004, with 33 being sampled during the sturgeon season. The average fork length was 426.3 mm for the sturgeon season compared to 416.5 for the fish community season (Figure 55). The length range for sauger sampled during the sturgeon season was 318 to 492 mm compared to 380 to 477 mm for the fish community season.

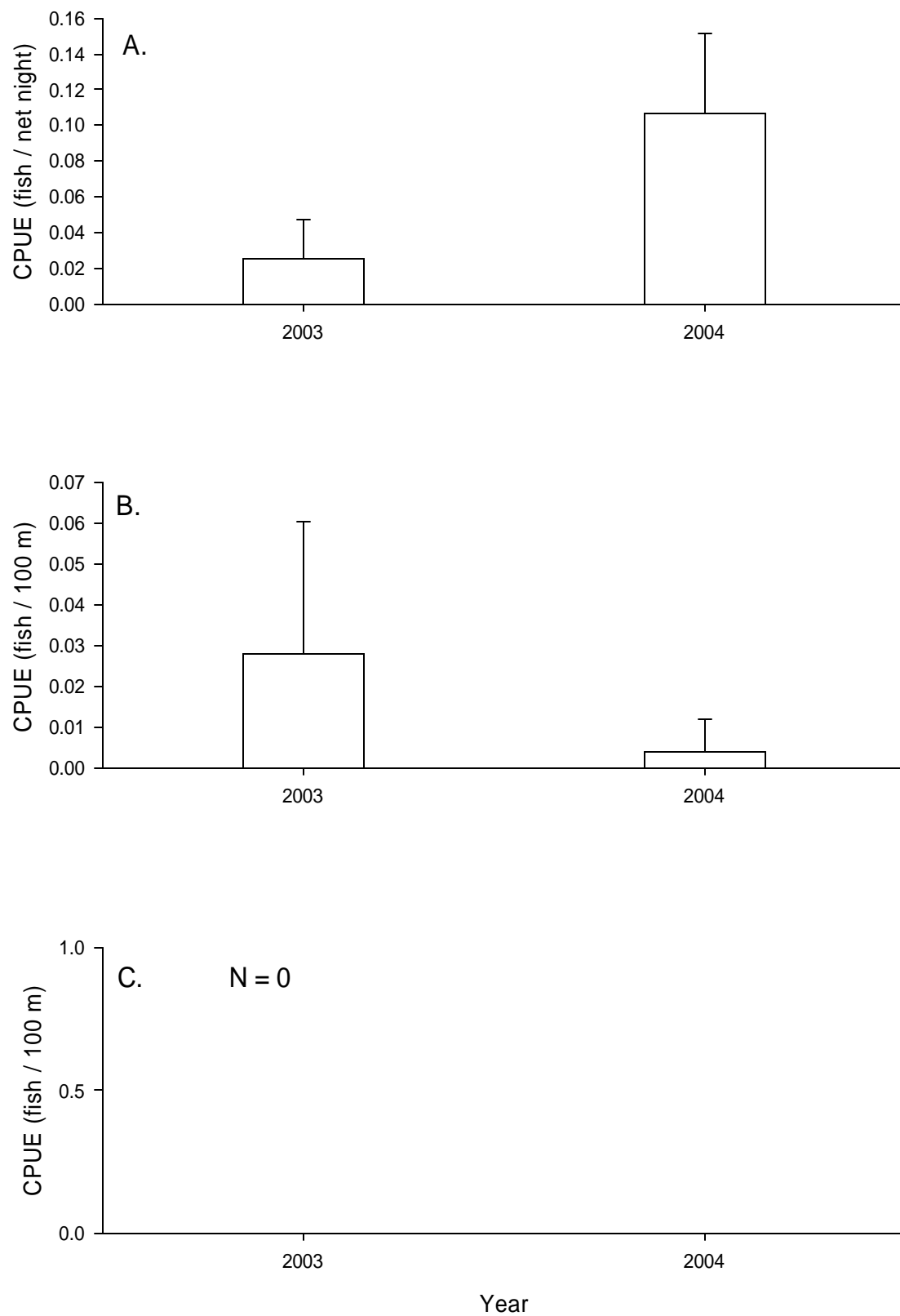


Figure 50. Mean annual catch-per-unit-effort (± 2 SE) of sauger in segment 9 of the Missouri River for: A) gill nets, B) trammel nets and C) otter trawls during the sturgeon season during 2003 and 2004.

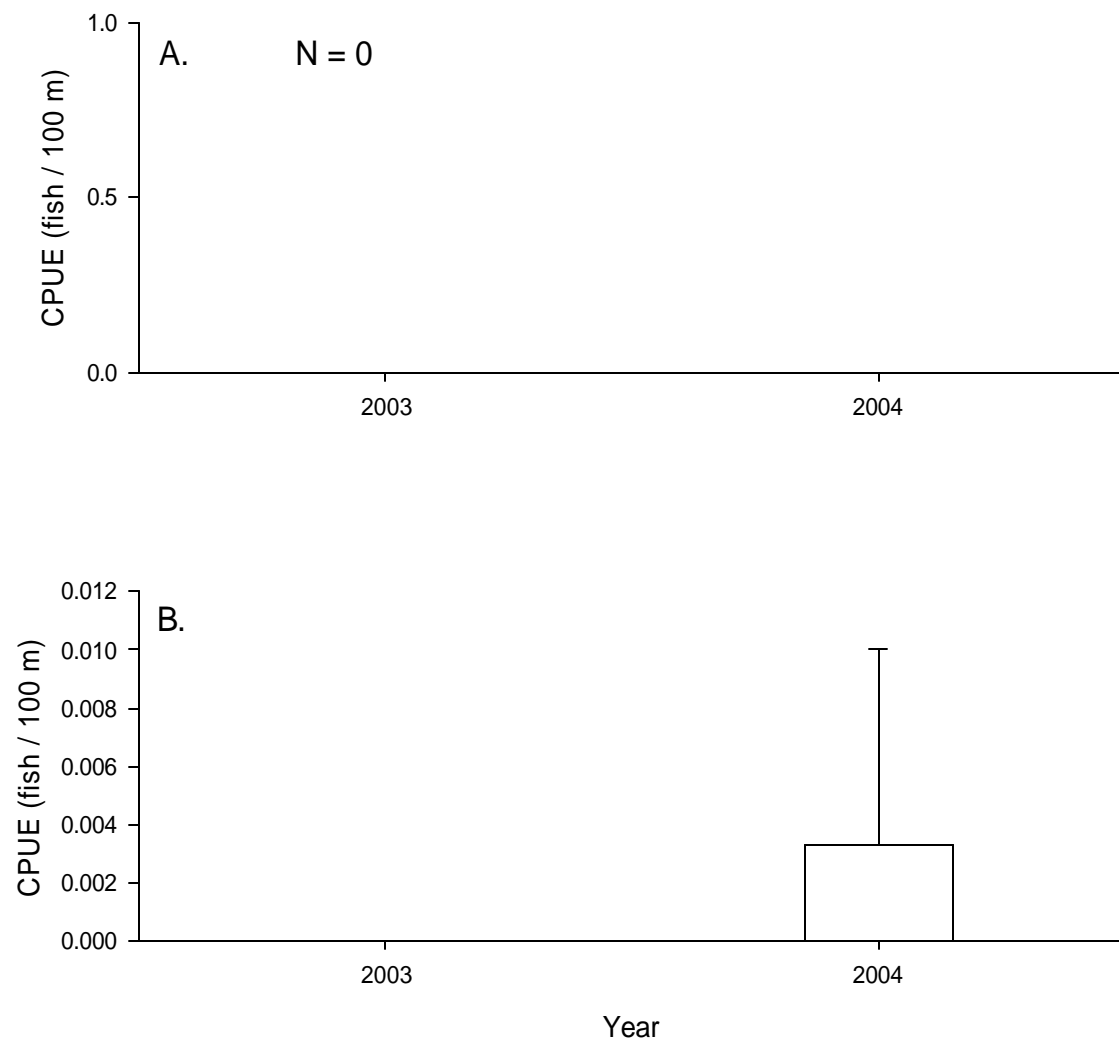


Figure 51. Mean annual catch-per-unit-effort (± 2 SE) of sauger in segment 9 of the Missouri River for: A) trammel nets and B) otter trawls during the fish community season during 2003 and 2004.

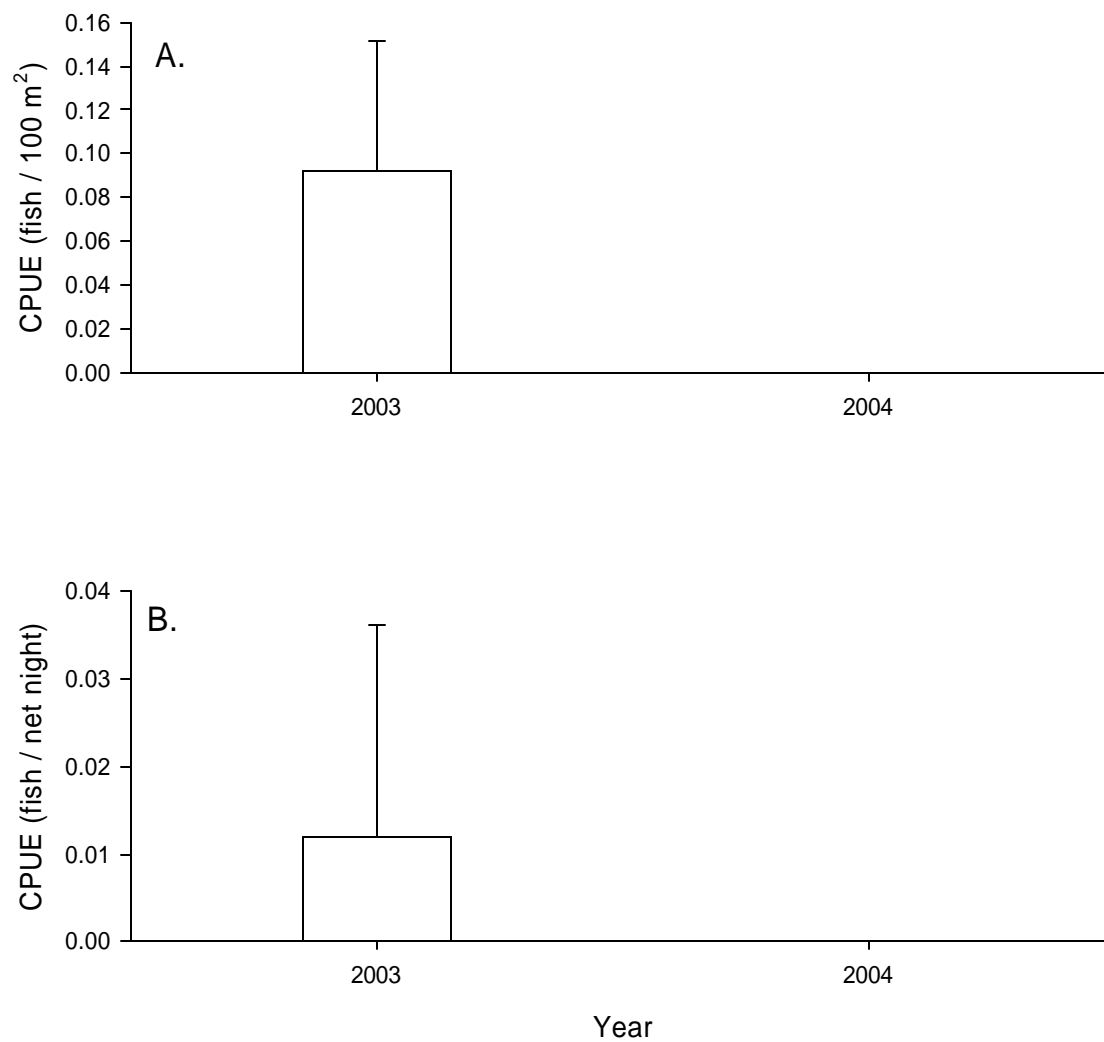


Figure 52. Mean annual catch-per-unit-effort (± 2 SE) of sauger in segment 9 of the Missouri River for: A) seining and B) mini-fyke nets during the fish community season during 2003 and 2004.

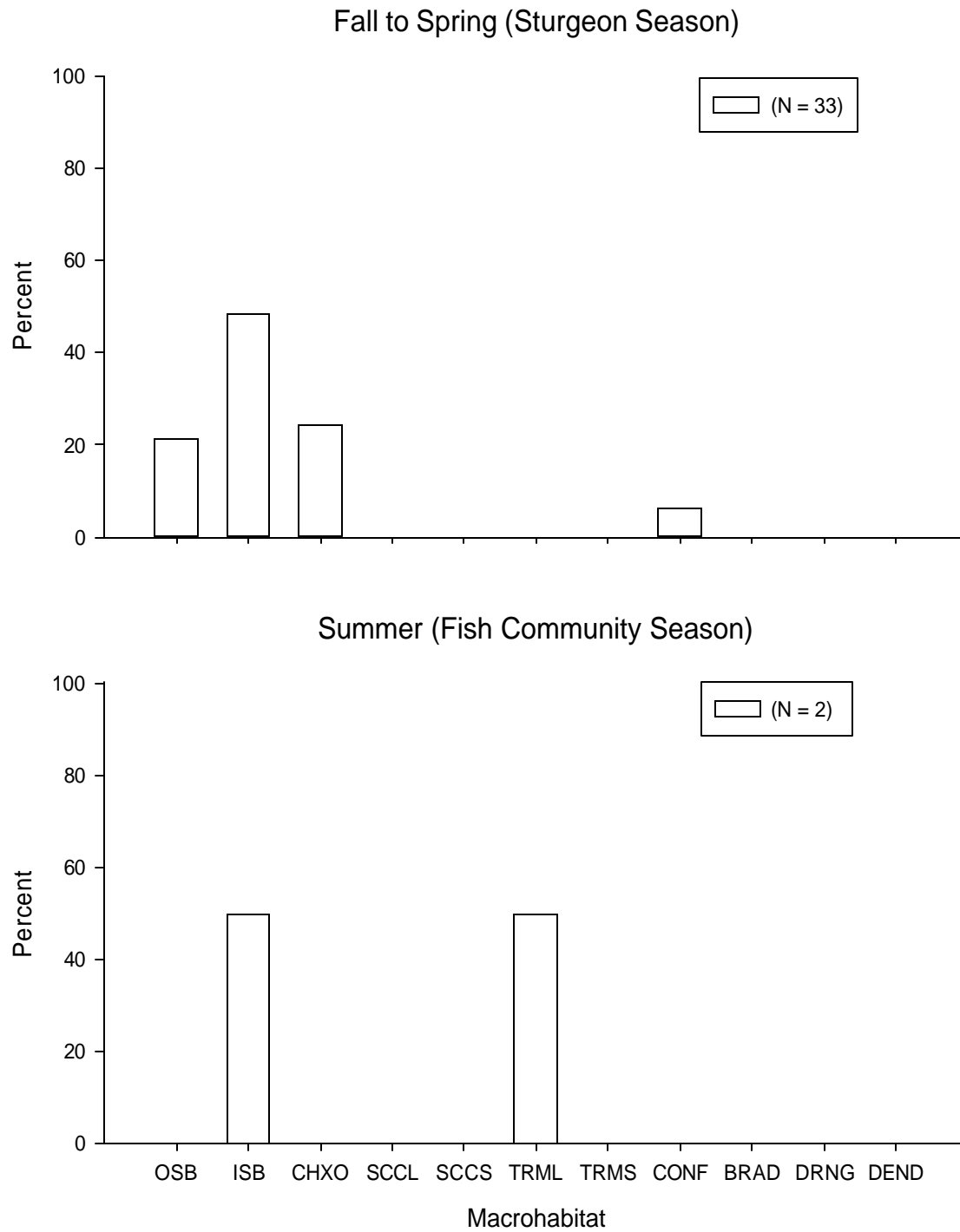


Figure 53. Percent of total sauger caught in each macrohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

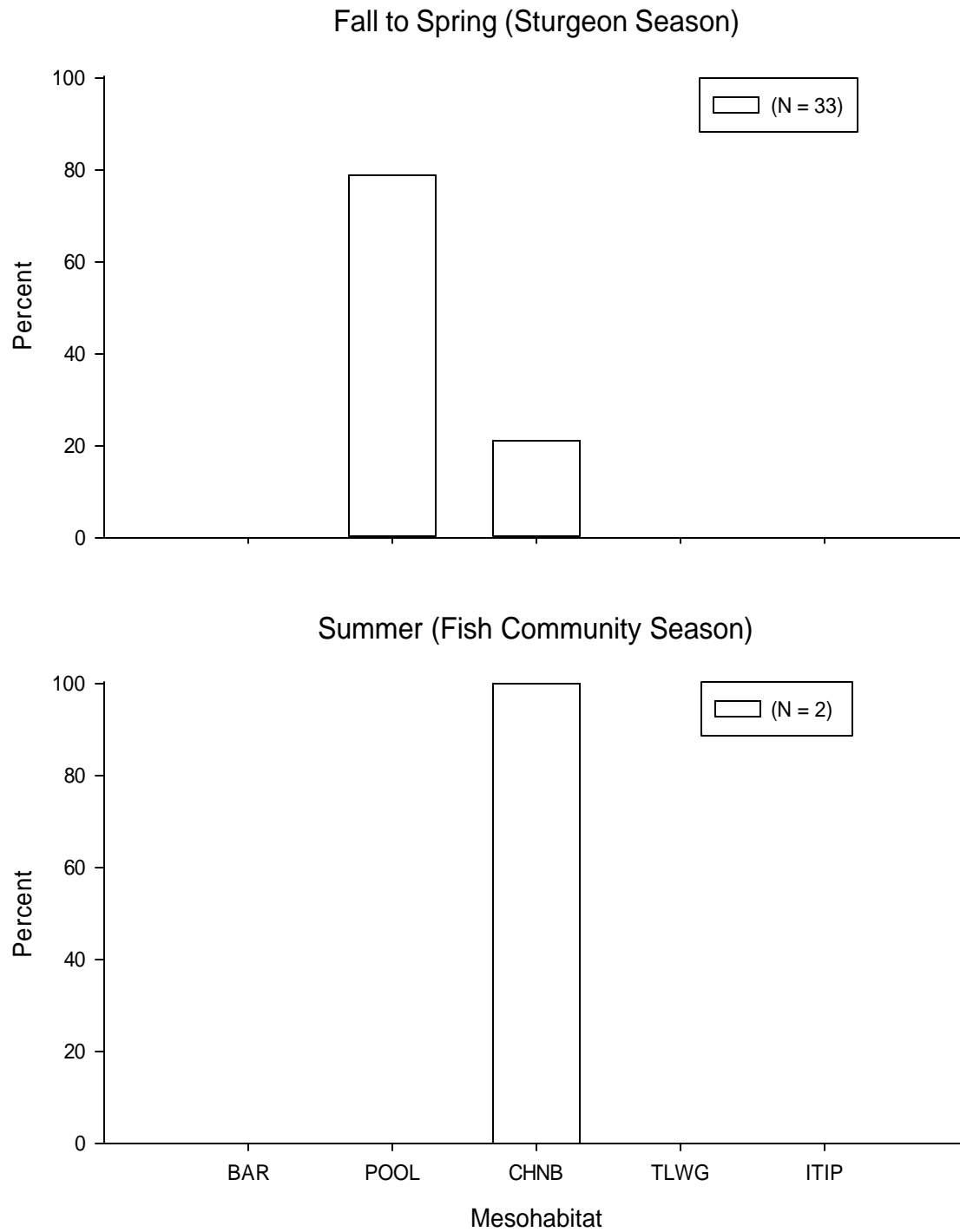


Figure 54. Percent of total sauger caught in each mesohabitat type in segment 9 of the Missouri River during 2004 for two seasons: Sturgeon and fish community season. Habitat abbreviations presented in Appendix B.

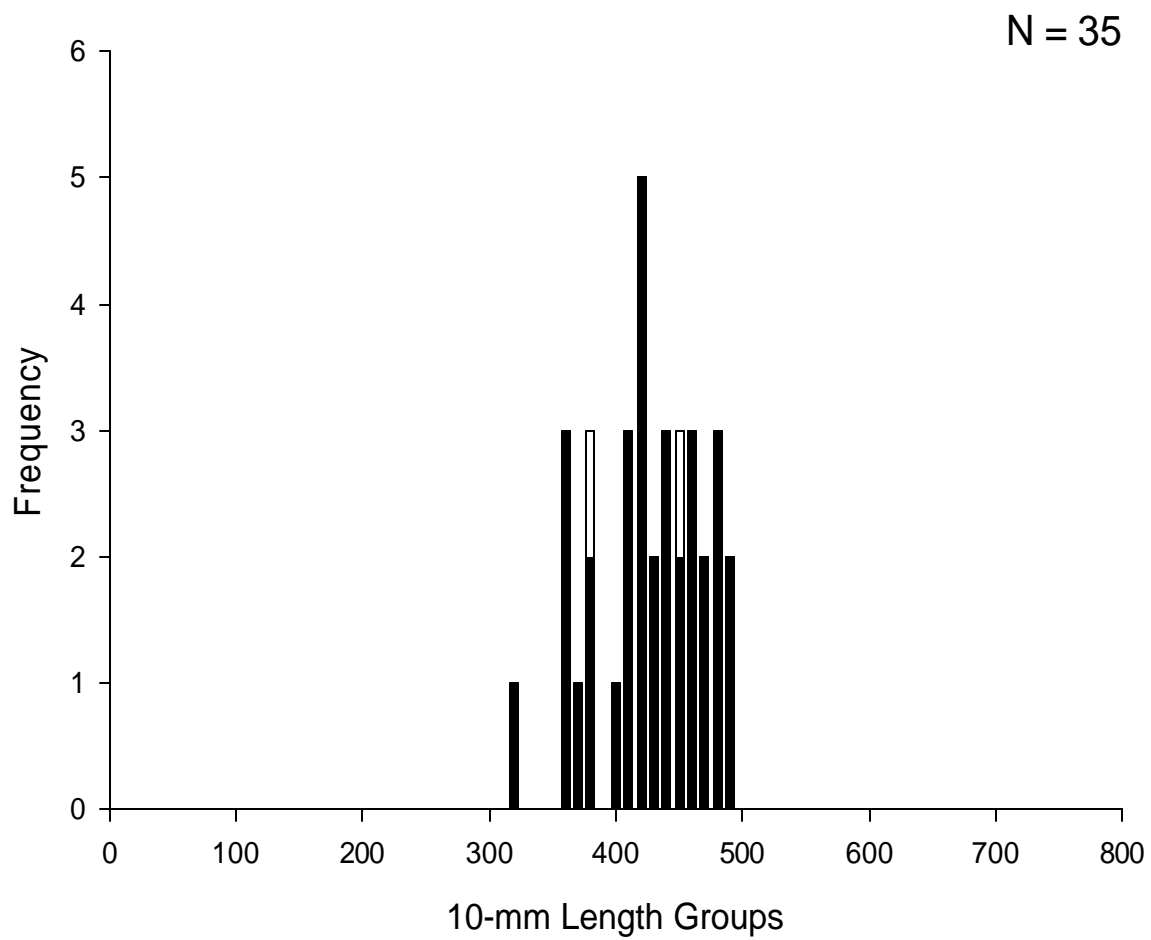


Figure 55. Length frequency of sauger during the sturgeon season (black bars) and the fish community season (white bars) in segment 9 of the Missouri River during 2004.

General Missouri River Fish community

Sturgeon season

In 2003, a total of 2,988 fish representing 26 species were captured in 200 gill net-nights with a CPUE of 14.94 fish per net-night (Steffensen and Mestl, 2004). In 2004, a total of 2,573 fish, representing 23 species were captured in 289 gill net-nights, with a total CPUE of 8.9 fish per net-night (Appendix E). Six species were sampled in 2003 that were not sampled in 2004; lake sturgeon, skipjack herring, quillback, flathead catfish, wiper and white bass. Three species were sampled in 2004 that were not sampled in 2003; pallid x shovelnose hybrid, silver carp and white sucker. In 2004, shovelnose sturgeon were the most frequently captured species with a CPUE of 6.9 fish per net-night and goldeye (*Hiodon alosoides*) were second (1.0 fish per net-night).

In 2003, a total of 727 fish representing 22 species were captured in 20,380 meters of trawling with a CPUE of 3.6 fish per 100 m trawled. In 2004, a total of 692 fish, representing 18 species were captured in 11,436 meters of trawling, with a total CPUE of 6.1 fish per 100 m trawled (Appendix F). Seven species were sampled in 2003 that were not sampled in 2004; pallid sturgeon, shortnose gar, sand shiner, common carp, shorthead redhouse, blue catfish and walleye. Three species were sampled in 2004 that were not sampled in 2003; goldeye, red shiner and common carp. In 2004, channel catfish were the most frequently captured species with a CPUE of 3.5 fish per 100 m trawled, shovelnose sturgeon were second (0.8 fish per 100 m trawled) and sicklefin chubs were third (0.7 fish per 100 m trawled).

In 2003, a total of 249 fish representing 15 species were captured in 10,196 meters of drifting trammel nets with a CPUE of 2.4 fish per 100 m drifted. In 2004, a total of 299 fish, representing 19 species were captured in 8,843 meters of drifting trammel nets with a total CPUE

of 3.4 fish per 100 m drifted (Appendix G). Two species were sampled in 2003 that were not sampled in 2004; skipjack herring and river carpsucker. Six species were sampled in 2003 that were not sampled in 2004; pallid sturgeon, grass carp, smallmouth buffalo, blue catfish, white bass and freshwater drum. In 2004, shovelnose sturgeon were the most frequently captured species with a CPUE of 1.9 fish per 100 m drifted, goldeye were second (0.3 fish per 100 m drifted) and blue suckers were third (0.3 fish per 100 m drifted).

Fish community season

In 2003, a total of 899 fish representing 24 species were captured in 12,424 meters of trawling with a CPUE of 7.2 fish per 100 m trawled. In 2004, a total of 1,103 fish, representing 23 species were captured in 13,047 meters of trawling with a total CPUE of 8.5 fish per 100 m trawled (Appendix H). Six species were sampled in 2003 that were not sampled in 2004; shortnose gar, gizzard shad, smallmouth buffalo, orangespotted sunfish, white crappie and walleye. Five species were sampled in 2004 that were not sampled in 2003; pallid sturgeon paddlefish, stonecat, brook silverside and sauger. In 2004, channel catfish were the most frequently captured species with a CPUE of 3.5 fish per 100 m trawled, silver chubs were second (1.4 fish per 100 m trawled) and speckled chub were third (1.1 fish per 100 m trawled).

In 2003, a total of 311 fish representing 13 species were captured in 12,611 meters of drifting trammel nets with a CPUE of 2.5 fish per 100 m drifted. In 2004, a total of 517 fish, representing 14 species were captured in 9,827 meters of drifting trammel nets with a total CPUE of 5.3 fish per 100 m drifted (Appendix I). Two species were sampled in 2003 that were not sampled in 2004; shorthead redhorse and walleye. Three species were sampled in 2004 that were not sampled in 2003; pallid sturgeon, bigmouth buffalo and freshwater drum. In 2004,

shovelnose sturgeon were the most frequently captured species with a CPUE of 3.5 fish per 100 m drifted, blue suckers were second (0.9 fish per 100m drifted) and goldeye were third (0.1 fish per 100 m drifted).

In 2003, a total of 2,947 fish representing 31 species were captured in 80 seine hauls with a CPUE of 27.8 fish per 100 m². In 2004, a total of 1,739 fish, representing 29 species were captured in 80 seine hauls, with a CPUE of 18.8 fish per 100 m² (Appendix J). Eight species were sampled in 2003 that were not sampled in 2004; longnose gar, goldeye, unidentified Cyprinidea, spottail shiner, white crappie, johnny darter, sauger and walleye. Six species were sampled in 2004 that were not sampled in 2003; sturgeon chub, quillback, orangespotted sunfish, black crappie and yellow perch. In 2004, gizzard shad were the most frequently captured species with a CPUE of 5.8 fish per 100 m², emerald shiners were second (5.0 fish per 100 m²) and river shiners were third (2.1 fish per 100 m²).

In 2003, a total of 1,077 fish representing 32 species were captured in 83 net-nights with a CPUE of 13.0 fish per net-night. In 2004, a total of 1,770 fish, representing 32 species were captured in 79 net-nights with a CPUE of 22.4 fish per net-night (Appendix K). Eight species were sampled in 2003 that were not sampled in 2004; longnose gar, bighead carp, shorthead redhorse, yellow bullhead, smallmouth bass, black crappie, sauger and walleye. Eight species were sampled in 2004 that were not sampled in 2003; speckled chub, fathead minnow, quillback, blue catfish, western mosquitofish, brook silverside, unidentified *Lepomis* and unidentified Centrarchid. In 2004, emerald shiners were the most frequently captured species with a CPUE of 8.2 fish per net-night, river shiners were second (3.4 fish per net-night) and red shiners were third (2.9 fish per net-night).

DISCUSSION

Pallid sturgeon

Eleven pallid sturgeon were collected during the 2004 sampling season in segment 9 of the Missouri River. Gill nets were the most effective gear, collecting seven, six of which were sampled in pool habitats. Post-winter gill net samples were more productive than pre-winter sampling, with five pallid sturgeon being sampled during March and April. Gill net effectiveness on small sturgeon (less than 300 mm) needs to be examined due to poor catch rates and recapture data for stocked pallid sturgeon. During the first two years of this project, the smallest pallid sturgeon collected in a gill net was 390 mm and only seven shovelnose sturgeon less than 300 mm have been sampled. However, a smaller mesh size (25.4 mm (1.0”) or less) will gather more organic material, which may make the mesh ineffective after a couple hours and the nets may then create their own microhabitat by altering water velocities. Trammel nets and otter trawls are fairly ineffective, sampling only five pallid sturgeon during the last two years in almost 100 kilometers of effort. Hoop nets and beam trawls have not sampled a pallid sturgeon since this project originated. Both sampling methods have been removed from our standard sampling design. Pallid sturgeon were sampled in locations with a mean water depth of 2.85 m and an average bottom velocity of 0.28 mps. During winter gill netting, pallid sturgeon were collected in deeper water (3.1 m) and slower water velocities (0.18 mps) compared to trammel netting and otter trawling (2.4 m and 0.42 mps).

Over 35,000 hatchery reared pallid sturgeon were stocked in RPA #4 during 2004. Of these, 4,692 were from the 2003 year class and 30,628 were from the 2004 year class. During 2004, Nebraska Game and Parks Commission collected five hatchery pallid sturgeon. Two were from the 2003 year class and one was from the 2004 year class. Recaptured hatchery reared fish

were sampled from the Verdel, Bellevue, Leavenworth and Boonville stocking sites and from the Gavins Point Dam, Neosho and Garrison Dam National Fish Hatcheries.

Shovelnose sturgeon

Gill nets remained the most effective sampling method for shovelnose sturgeon, collecting over 71% of all shovelnose sturgeon during 2004. However, there was sharp decline in CPUE from 2003 to 2004 (12.0 to 6.9, respectively). The decline in CPUE can be attributed to the fact that during the 2003 sampling season gill nets were set exclusively in pool mesohabitats, compared to during the 2004 sampling season when sampling efforts were divided into pool and channel border mesohabitats. CPUE is consistently higher for pool sets (8.8 fish per net-night) compared to channel border sets (3.4 fish per net-night). Trammel nets were the second most effective gear for sampling shovelnose sturgeon (N = 221), sampling over twice as many compared to otter trawling (N = 85). We observed that drifting trammel nets outside of wing dike tips produced low catch rates and higher numbers of damaged or lost netting. A seventy-five meter drift between wing dikes is not always possible in this reach of the Missouri River due to wing dike placement on the bends.

Macrophybopsis

Otter trawling remained the most effective sampling method for all *Macrophybopsis* species. Otter trawling collected all of the sicklefin chubs, 21 of 24 sturgeon chubs and 209 of 280 speckled chubs throughout both seasons. Seining only collected four *Macrophybopsis* species and mini-fyke netting only collected 23 *Macrophybopsis* species. Overall catch for sicklefin chubs (34), sturgeon chubs (24) and speckled chubs (280) increased in 2004 compared to 2003 (sicklefin chubs (13), sturgeon chub (22) and speckled chubs (109)).

Hybognathus spp.

Seining and mini-fyke nets remained the only methods that collected plains minnows. CPUE for plains minnows while seining declined from 2003 to 2004 (11.2 fish per 100 m² to 1.5 fish per 100 m², respectively). This can be attributed to a single seine haul that collected over one thousand plains minnows in 2003.

Sand shiners

Seining and mini-fyke nets remained the most effective method to collect sand shiners. Overall catch rate for sand shiners increased from 2003 to 2004 (100 to 160, respectively). CPUE for seining declined from 2003 to 2004 (0.8 fish per 100 m² to 0.3 fish per 100 m²), while CPUE for mini-fyke netting increased from 2003 to 2004 (< 0.1 fish per net-night to 1.5 fish per net-night).

Bigmouth buffalo

Only seventeen bigmouth buffalo have been sampled during the first two years of this project. Hoop nets and trammel nets were the most effective method for collecting bigmouth buffalo. Each gear accounted for 2 fish during the 2004 sampling season.

Blue sucker

Hoop nets were the most effective sampling method for blue suckers, collecting over 36% (161) of all blue suckers during 2004, followed by gill nets which collected an additional 150 fish. This differed when compared to 2003 catch rates when trammel nets were the most productive gear.

Sauger

Only 53 sauger have been sampled during the first two years of this project. Gill nets sampled over 91% of all sauger collected during 2004, with 26 of 32 being collected in pool mesohabitats.

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Appendix A. Phylogenetic list of Missouri River fishes with corresponding letter and numeric codes used in the long-term pallid sturgeon and associated fish community sampling program. The phylogeny follows that used by the American Fisheries Society, Common and Scientific Names of Fishes from the United States and Canada, 5th edition. Asterisks and bold type denote targeted native Missouri River species.

Scientific name	Common name	Letter Code
CLASS CEPHALASPIDOMORPHI-LAMPREYS		
ORDER PETROMYZONTIFORMES		
Petromyzontidae – lampreys		
<i>Ichthyomyzon castaneus</i>	Chestnut lamprey	CNLP
<i>Ichthyomyzon fossor</i>	Northern brook lamprey	NBLP
<i>Ichthyomyzon unicuspis</i>	Silver lamprey	SVLP
<i>Ichthyomyzon gagei</i>	Southern brook lamprey	SBLR
Petromyzontidae	Unidentified lamprey	ULY
Petromyzontidae larvae	Unidentified larval lamprey	LVL
CLASS OSTEICHTHYES – BONY FISHES		
ORDER ACIPENSERIFORMES		
Acipenseridae – sturgeons		
<i>Acipenser fulvescens</i>	Lake sturgeon	LKSG
<i>Scaphirhynchus</i> spp.	Unidentified Scaphirhynchus	USG
<i>Scaphirhynchus albus</i>	Pallid sturgeon	PDSG*
<i>Scaphirhynchus platyrhynchus</i>	Shovelnose sturgeon	SNSG*
<i>S. albus</i> X <i>S. platyrhynchus</i>	Pallid-shovelnose hybrid	SNPD
Polyodontidae – paddlefishes		
<i>Polyodon spathula</i>	Paddlefish	PDFH
ORDER LEPISOSTEIFORMES		
Lepisosteidae – gars		
<i>Lepisosteus oculatus</i>	Spotted gar	STGR
<i>Lepisosteus osseus</i>	Longnose gar	LNGR
<i>Lepisosteus platostomus</i>	Shortnose gar	SNGR
ORDER AMMIFORMES		
Amiidae – bowfins		
<i>Amia calva</i>	Bowfin	BWFN
ORDER OSTEOGLOSSIFORMES		
Hiodontidae – mooneyes		
<i>Hiodon alosoides</i>	Goldeye	GDEY
<i>Hiodon tergisus</i>	Mooneye	MNEY
ORDER ANGUILLIFORMES		
Anguillidae – freshwater eels		
<i>Anguilla rostrata</i>	American eel	AMEL

Appendix A. (continued).

Scientific name	Common name	Letter Code
ORDER CLUPEIFORMES		
Clupeidae – herrings		
<i>Alosa alabame</i>	Alabama shad	ALSD
<i>Alosa chrysochloris</i>	Skipjack herring	SJHR
<i>Alosa pseudoharengus</i>	Alewife	ALWF
<i>Dorosoma cepedianum</i>	Gizzard shad	GZSD
<i>Dorosoma petenense</i>	Threadfin shad	TFSD
<i>D. cepedianum</i> X <i>D. petenense</i>	Gizzard-threadfin shad hybrid	GSTS
ORDER CYPRINIFORMES		
Cyprinidae – carps and minnows		
<i>Campostoma anomalum</i>	Central stoneroller	CLSR
<i>Campostoma oligolepis</i>	Largescale stoneroller	LSSR
<i>Carassus auratus</i>	Goldfish	GDFH
<i>Carassus auratus</i> X <i>Cyprinus carpio</i>	Goldfish-Common carp hybrid	GFCC
<i>Couesius plumbens</i>	Lake chub	LKCB
<i>Ctenopharyngodon idella</i>	Grass carp	GSCP
<i>Cyprinella lutrensis</i>	Red shiner	RDSN
<i>Cyprinella spiloptera</i>	Spotfin shiner	SFSN
<i>Cyprinus carpio</i>	Common carp	CARP
<i>Erimystax x-punctatus</i>	Gravel chub	GVCB
<i>Hybognathus argyritis</i>	Western slivery minnow	WSMN*
<i>Hybognathus hankinsoni</i>	Brassy minnow	BSMN
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	SVMW
<i>Hybognathus placitus</i>	Plains minnow	PNMW*
<i>Hybognathus</i> spp.	Unidentified Hybognathus	HBNS
<i>Hypophthalmichthys molitrix</i>	Silver carp	SVCP
<i>Hypophthalmichthys nobilis</i>	Bighead carp	BHCP
<i>Luxilus chrysocephalus</i>	Striped shiner	SPSN
<i>Luxilus cornutus</i>	Common shiner	CMSN
<i>Luxilus zonatus</i>	Bleeding shiner	BDSN
<i>Lythrurus unbratilis</i>	Western redbfin shiner	WRFS
<i>Macrhybopsis aestivalis</i>	Speckled chub	SKCB*
<i>Macrhybopsis gelida</i>	Sturgeon chub	SGCB*
<i>Macrhybopsis meeki</i>	Sicklefin chub	SFCB*
<i>Macrhybopsis storeriana</i>	Silver chub	SVCB
<i>M. aestivalis</i> X <i>M. gelida</i>	Speckled-Sturgeon chub hybrid	SPST
<i>M. gelida</i> X <i>M. meeki</i>	Sturgeon-Sicklefin chub hybrid	SCSC
<i>Macrhybopsis</i> spp.	Unidentified chub	UHY
<i>Margariscus margarita</i>	Pearl dace	PLDC
<i>Mylocheilus caurinus</i>	Peamouth	PEMT
<i>Nocomis biguttatus</i>	Hornyhead chub	HHCB
<i>Notemigonus crysoleucas</i>	Golden shiner	GDSN
<i>Notropis atherinoides</i>	Emerald shiner	ERSN
<i>Notropis blennius</i>	River shiner	RVSN
<i>Notropis boops</i>	Bigeye shiner	BESN
<i>Notropis buchanani</i>	Ghost shiner	GTSN
<i>Notropis dorsalis</i>	Bigmouth shiner	BMSN
<i>Notropis greeniei</i>	Wedgespot shiner	WSSN

Appendix A. (continued).

Scientific name	Common name	Letter Code
Cyprinidae – carps and minnows		
<i>Notropis heterolepsis</i>	Blacknose shiner	BNSN
<i>Notropis hudsonius</i>	Spottail shiner	STSN
<i>Notropis nubilus</i>	Ozark minnow	OZMW
<i>Notropis rubellus</i>	Rosyface shiner	RYSN
<i>Notropis shumardi</i>	Silverband shiner	SBSN
<i>Notropis stilbuis</i>	Silverstripe shiner	SSPS
<i>Notropis stramineus</i>	Sand shiner	SNSN*
<i>Notropis topeka</i>	Topeka shiner	TPSN
<i>Notropis volucellus</i>	Mimic shiner	MMSN
<i>Notropis wickliffi</i>	Channel shiner	CNSN
<i>Notropis</i> spp.	Unidentified shiner	UNO
<i>Opsopoeodus emiliae</i>	Pugnose minnow	PNMW
<i>Phenacobius mirabilis</i>	Suckermouth minnow	SMMW
<i>Phoxinus eos</i>	Northern redbelly dace	NRBD
<i>Phoxinus erythrogaster</i>	Southern redbelly dace	SRBD
<i>Phoxinus neogaeus</i>	Finescale dace	FSDC
<i>Pimephales notatus</i>	Bluntnose minnow	BNMW
<i>Pimephales promelas</i>	Fathead minnow	FHMW
<i>Pimephales vigilas</i>	Bullhead minnow	BHMW
<i>Platygobio gracilis</i>	Flathead chub	FHCB
<i>P. gracilis</i> X <i>M. meeki</i>	Flathead-sicklefin chub hybrid	FCSC
<i>Rhinichthys atratulus</i>	Blacknose dace	BNDC
<i>Rhinichthys cataractae</i>	Longnose dace	LNDC
<i>Richardsonius balteatus</i>	Redside shiner	RDSS
<i>Scardinius erythrophthalmus</i>	Rudd	RUDD
<i>Semotilus atromaculatus</i>	Creek chub	CKCB
	Unidentified Cyprinidae	UCY
Catostomidae - suckers		
<i>Carpionodes carpio</i>	River carpsucker	RVCP
<i>Carpionodes cyprinus</i>	Quillback	QLBK
<i>Carpionodes velifer</i>	Highfin carpsucker	HFCS
<i>Carpionodes</i> spp.	Unidentified <i>Carpionodes</i>	UCS
<i>Catostomus catostomus</i>	Longnose sucker	LNSK
<i>Catostomus commersoni</i>	White sucker	WTSK
<i>Catostomus platyrhincus</i>	Mountain sucker	MTSK
<i>Catostomus</i> spp.	Unidentified <i>Catostomus</i> spp.	
<i>Cycleptus elongates</i>	Blue sucker	BUSK*
<i>Hypentelium nigricans</i>	Northern hog sucker	NHSK
<i>Ictiobus bubalus</i>	Smallmouth buffalo	SMBF
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo	BMBF*
<i>Ictiobus niger</i>	Black buffalo	BKBF
<i>Ictiobus</i> spp.	Unidentified buffalo	UBF
<i>Minytrema melanops</i>	Spotted sucker	SPSK
<i>Moxostoma anisurum</i>	Silver redhorse	SVRH
<i>Moxostoma carinatum</i>	River redhorse	RVRH
<i>Moxostoma duquesnei</i>	Black redhorse	BKRH
<i>Moxostoma erythrurum</i>	Golden redhorse	GDRH
<i>Moxostoma macrolepidotum</i>	Shorthead redhorse	SHRH
<i>Moxostoma</i> spp.	Unidentified redhorse	URH

Appendix A. (continued).

Scientific name	Common name	Letter Code
Catostomidae - suckers	Unidentified Catostomidae	UCT
Ictaluridae – bullhead catfishes	ORDER SILURIFORMES	
<i>Ameiurus melas</i>	Black bullhead	BKBH
<i>Ameiurus natalis</i>	Yellow bullhead	YLBH
<i>Ameiurusnebulosus</i>	Brown bullhead	
<i>Ameiurus</i> spp.	Unidentified bullhead	
<i>Ictalurus furcatus</i>	Blue catfish	BLCF
<i>Ictalurus punctatus</i>	Channel catfish	CNCF
<i>I. furcatus</i> X <i>I. punctatus</i>	Blue-channel catfish hybrid	BCCC
<i>Ictalurus</i> spp.	Unidentified <i>Ictalurus</i> spp.	
<i>Noturus exilis</i>	Slender madtom	SDMT
<i>Noturus flavus</i>	Stonecat	STCT
<i>Noturus gyrinus</i>	Tadpole madtom	TPMT
<i>Noturus nocturnes</i>	Freckled madtom	FKMT
<i>Pylodictis olivaris</i>	Flathead catfish	FHCF
	Unidentified – not <i>Ictalurus</i>	UCF
	ORDER SALMONIFORMES	
Esocidae - pikes		
<i>Esox americanus vermiculatus</i>	Grass pickerel	GSPK
<i>Esox lucius</i>	Northern pike	NTPK
<i>Esox masquinongy</i>	Muskellunge	MSKG
<i>E. lucius</i> X <i>E. masquinongy</i>	Tiger Muskellunge	
Umbridae - mudminnows		
<i>Umbra limi</i>	Central mudminnow	
Osmeridae - smelts		
<i>Osmerus mordax</i>	Rainbow smelt	RBST
Salmonidae - trouts		
<i>Coregonus artedii</i>	Lake herring or cisco	CSCO
<i>Coregonus clupeaformis</i>	Lake whitefish	LKWF
<i>Oncorhynchus aguabonita</i>	Golden trout	GDTT
<i>Oncorhynchus clarki</i>	Cutthroat trout	CTTT
<i>Oncorhynchus kisutch</i>	Coho salmon	CHSM
<i>Oncorhynchus mykiss</i>	Rainbow trout	RBTT
<i>Oncorhynchus nerka</i>	Sockeye salmon	SESM
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	CNSM
<i>Prosopium cylindraceum</i>	Bonville cisco	BVSC
<i>Prosopium williamsoni</i>	Mountain whitefish	MTWF
<i>Salmo trutta</i>	Brown trout	BNTT
<i>Salvelinus fontinalis</i>	Brook trout	BKTT
<i>Salvelinus namaycush</i>	Lake trout	LKTT
<i>Thymallus arcticus</i>	Arctic grayling	AMGL

Appendix A. (continued).

Scientific name	Common name	Letter Code
ORDER PERCOPSIFORMES		
Percopsidae – trout-perches		
<i>Percopsis omiscomaycus</i>	Trout-perch	TTPH
ORDER GADIFORMES		
Gadidae - cods		
<i>Lota lota</i>	Burbot	BRBT
ORDER ATHERINIFORMES		
Cyprinodontidae - killifishes		
<i>Fundulus catenatus</i>	Northern studfish	NTSF
<i>Fundulus daphanus</i>	Banded killifish	BDKF
<i>Fundulus notatus</i>	Blackstripe topminnow	BSTM
<i>Fundulus olivaceus</i>	Blackspotted topminnow	BPTM
<i>Fundulus sciadicus</i>	Plains topminnow	PTMW
<i>Fundulus zebrinus</i>	Plains killifish	PKLF
Poeciliidae - livebearers		
<i>Gambusia affinis</i>	Western mosquitofish	MQTF
Atherinidae - silversides		
<i>Labidesthes sicculus</i>	Brook silverside	BKSS
ORDER GASTEROSTEIFORMES		
Gasterosteidae - sticklebacks		
<i>Culea inconstans</i>	Brook stickleback	BKSB
ORDER SCORPAENIFORMES		
Cottidae - sculpins		
<i>Cottus bairdi</i>	Mottled sculpin	MDSP
<i>Cottus carolinae</i>	Banded sculpin	BDSP
ORDER PERCIFORMES		
Percichthyidae – temperate basses		
<i>Morone Americana</i>	White perch	WTPH
<i>Morone chrysops</i>	White bass	WTBS
<i>Morone mississippiensis</i>	Yellow bass	YWBS
<i>Morone saxatilis</i>	Striped bass	SDBS
<i>M. saxatilis</i> X <i>M. chrysops</i>	Striped-white bass hybrid	
Centrarchidae - sunfishes		
<i>Ambloplites rupestris</i>	Rock bass	RKBS
<i>Archoplites interruptus</i>	Sacramento perch	
<i>Lepomis cyanellus</i>	Green sunfish	GNSF
<i>Lepomis gibbosus</i>	Pumpkinseed	PNSD
<i>Lepomis gulosus</i>	Warmouth	WRMH
<i>Lepomis humilis</i>	Orangespotted sunfish	OSSF

Appendix A. (continued).

Scientific name	Common name	Letter Code
Centrarchidae - sunfishes		
<i>Lepomis macrochirus</i>	Bluegill	BLGL
<i>Lepomis magalotis</i>	Longear sunfish	LESF
<i>Lepomis microlophus</i>	Redear sunfish	
<i>L. cyanellus</i> X <i>L. macrochirus</i>	Green sunfish-bluegill hybrid	GSBG
<i>L. cyanellus</i> X <i>L. spp?</i>	Unknown Green sunfish hybrid	GN*?
<i>L. cyanellus</i> X <i>L. humilis</i>	Green-orangespotted sunfish hybrid	GSOS
<i>L. macrochirus</i> X <i>L. microlophus</i>	Bluegill-redear sunfish hybrid	
<i>Lepomis</i> spp.	Unidentified <i>Lepomis</i>	ULP
<i>Micropterus dolomieu</i>	Smallmouth bass	SMBS
<i>Micropterus punctatus</i>	Spotted sunfish	STBS
<i>Micropterus salmoides</i>	Largemouth bass	LMBS
<i>Micropterus</i> spp.	Unidentified <i>Micropterus</i> spp.	
<i>Pomoxis annularis</i>	White crappie	WTCP
<i>Pomoxis nigromaculatus</i>	Black crappie	BKCP
<i>Pomoxis</i> spp.	Unidentified crappie	
<i>P. annularis</i> X <i>P. nigromaculatus</i>	White-black crappie hybrid	
Centrarchidae	Unidentified centrarchid	UCN
Percidae - perches		
<i>Ammocrypta asprella</i>	Crystal darter	CLDR
<i>Etheostoma blennioides</i>	Greenside darter	GSDR
<i>Etheostoma caeruleum</i>	Rainbow darter	RBDR
<i>Etheostoma exile</i>	Iowa darter	IODR
<i>Etheostoma flabellare</i>	Fantail darter	FTDR
<i>Etheostoma gracile</i>	Slough darter	SLDR
<i>Etheostoma microperca</i>	Least darter	LTDR
<i>Etheostoma nigrum</i>	Johnny darter	JYDR
<i>Etheostoma punctulatum</i>	Stippled darter	STPD
<i>Etheostoma spectabile</i>	Orangethroated darter	OTDR
<i>Etheostoma tetrazonum</i>	Missouri saddled darter	MSDR
<i>Etheostoma zonale</i>	Banded darter	BDDR
<i>Etheostoma</i> spp.	Unidentified <i>Etheostoma</i> spp.	UET
<i>Perca flavescens</i>	Yellow perch	YWPH
<i>Percina caproides</i>	Logperch	LGPH
<i>Percina cymatotaenia</i>	Bluestripe darter	BTDR
<i>Percina evides</i>	Gilt darter	GLDR
<i>Percina maculate</i>	Blackside darter	BSDR
<i>Percina phoxocephala</i>	Slenderhead darter	SHDR
<i>Percina shumardi</i>	River darter	RRDR
<i>Percina</i> spp.	Unidentified <i>Percina</i> spp.	UPN
	Unidentified darter	UDR
<i>Zander canadense</i>	Sauger	SGER*
<i>Zander vitreum</i>	Walleye	WLEY
<i>Z. canadense</i> X <i>Z. vitreum</i>	Sauger-walleye hybrid/Saugeye	SGWE
<i>Zander</i> spp.	Unidentified <i>Zander</i> (formerly <i>Stizostedion</i>) spp.	UST
Percidae	Unidentified percidae	UPC

Appendix A. (continued).

Scientific name	Common name	Letter Code
Sciaenidae - drums		
<i>Aplodinotus grunniens</i>	Freshwater drum	FWDM
NON-TAXONOMIC CATEGORIES		
	Age-0/Young-of-year fish	YOYF
	Lab fish for identification	LAB
	No fish caught	NFSH
	Unidentified larval fish	LVFS
	Unidentified	UNID

Appendix B. Definitions and codes used to classify standard Missouri River habitats in the long-term pallid sturgeon and associated fish community sampling program. Three habitat scales were used in the hierarchical habitat classification system: macrohabitats, mesohabitats, and microhabitats.

Habitat	Scale	Definition	Code
Main channel cross over	Macro	The inflection point of the thalweg where the thalweg crosses from one concave side of the river to the other concave side of the river, (i.e., transition zone from one-bend to the next bend). The upstream CHXO for a respective bend is the one sampled.	CHXO
Main channel outside bend	Macro	The concave side of a river bend	OSB
Main channel inside bend	Macro	The convex side of a river bend	ISB
Secondary channel-connected large	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, large indicates this habitat can be sampled with trammel nets and trawls based on width and/or depths > 1.2 m	SCCL
Secondary channel-connected small	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, small indicates this habitat cannot be sampled with trammel nets and trawls based on width and/or on depths < 1.2 m	SCCS
Tributary small mouth	Macro	Mouth of entering tributary whose mean annual discharge is < 20 m ³ /s, mouth width is > 6 m wide and the sample area extends 300 m into the tributary	TRMS
Tributary large mouth	Macro	Mouth of entering tributary whose mean annual discharge is > 20 m ³ /s, and the sample area extends 300 m into the tributary	TRML
Tributary confluence	Macro	Area immediately downstream, extending up to one bend in length, from a junction of a large tributary and the main river where this tributary has influence on the physical features of the main river	CONF
Braided channel	Macro	Riverine area with multiple channels separated by sand bar complexes, no well-defined main channel exists	BRAD
Deranged channel	Macro	Where a braided channel coalesces into a single well-defined main channel	DRNG
Dendritic channel	Macro	Where a single well-defined main channel separates into a braided channel, opposite of deranged channel	DEND
Dam tailwaters	Macro	Area immediately downstream of a dam	DTWT

Bars	Meso	Sandbar or shallow bank-line areas with depth < 1.2 m	BAR
Pools	Meso	Areas immediately downstream from sandbars, dikes, snags, or other obstructions with a formed scour hole > 1.2 m	POOL
Channel border	Meso	Area in the channelized river between the toe and the thalweg, area in the unchannelized river between the toe and the maximum depth	CHNB
Thalweg	Meso	Main channel between the channel borders conveying the majority of the flow	TLWG
Island tip	Meso	Area immediately downstream of a bar or island where two channels converge with water depths > 1.2 m	ITIP
Steep	Micro	Area where water depth increases by 1.2 m or more within a 3 m distance. Does not necessarily have to be associated with a bank-line or bar	ST

Appendix C. List of standard and wild gears (type), their corresponding codes in the database, seasons deployed (sturgeon, fish community or all), years used, and catch-per-unit-effort units for collection of Missouri River fishes in segment 9 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2003 for segment 9.

Gear	Code	Type	Season	Years deployed	CPUE units
Trammel net	TN	Standard	All	2003 - Present	fish/100 m drift
Gillnet – 4 meshes, small mesh set upstream	GN14	Standard	Sturgeon	2003 - Present	fish/net-night
Gillnet – 4 meshes, large mesh set upstream	GN41	Standard	Sturgeon	2003 - Present	fish/net-night
Gillnet – 8 meshes, small mesh set upstream	GN18	Standard	Sturgeon	2003 – Present	fish/net-night
Gillnet – 8 meshes, large mesh set upstream	GN81	Standard	All	2003 – Present	fish/net-night
Otter trawl – 16 ft head rope	OT16	Standard	All	2003 – Present	fish/100 m trawled
Beam trawl	BT	Standard	All	2003 - 2004	fish/100 m trawled
Hoop net	HN	Standard	All	2003 – 2004	fish/net-night
Bag Seine – quarter arc method pulled upstream	BSQU	Standard	Fish Comm.	2003 - Present	fish/m ²
Bag Seine – quarter arc method pulled downstream	BSQD	Standard	Fish Comm.	2003 - Present	fish/m ²
Bag Seine – half arc method pulled upstream	BSHU	Standard	Fish Comm.	2003 - Present	fish/m ²
Bag Seine – half arc method pulled downstream	BSHD	Standard	Fish Comm.	2003 - Present	fish/m ²
Bag seine – rectangular method pulled upstream	BSRU	Standard	Fish Comm.	2003 - Present	fish/m ²
Bag seine – rectangular method pulled upstream	BSRD	Standard	Fish Comm.	2003 - Present	fish/m ²
Mini-fyke net	MF	Standard	Fish Comm.	2003 - Present	fish/net-night

Appendix D. Stocking locations and codes for pallid sturgeon by Recovery Priority Management Area (RPMA) in the Missouri River Basin.

State(s)	RPMA	Site Name	Code
MT	2	Wolf Point	WFP
MT	2	Culbertson	CBS
MT	2	Milk	MLK
MT	2	Brockton	BRK
MT	2	Poplar	POP
MT	2	Intake – Yellowstone River	INT
MT	2	Sidney – Yellowstone River	SID
MT	2	Fairview – Yellowstone River	FRV
MT	2	Above Intake – Yellowstone River	AIN
SD/NE	3	Sunshine Bottoms	SUN
SD/NE	3	Verdel Boat Ramp	VER
SD/NE	4	Mulberry Bend	MUL
NE/IA	4	Sioux City	SIO
NE/IA	4	Bellevue – Platte River Confluence	BEL
NE/MO	4	Rulo	RLO
MO/KS	4	Leavenworth	LEA
MO/KS	4	Kansas River	KSR
MO	4	Grand River	GDR
MO	4	Boonville	BOO
MO	4	Jefferson City	JEF
MO	4	Mokane	MOK
MO	4	Herman	HER

Appendix E. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/net-night) by mesohabitat within a macrohabitat for all species caught with gillnets during the sturgeon season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB		ISB		CHXO		TRML
Macro-Meso-			CHNB	POOL	CHNB	POOL	CHNB	POOL	
Ascipenseridae – sturgeons									
PDSG*	7	0.03 (0.02)		0.03 (0.06)		0.03 (0.03)	0.04 (0.08)		
SNSG*	2019	6.89 (1.61)	2.63 (3.68)	5.17 (4.31)	2.83 (1.60)	7.88 (1.87)	2.88 (1.41)	13.72 (8.53)	7.00 (0.00)
SNPD	1	< 0.01 (0.01)			0.02 (0.04)				
Polyodontidae – paddlefishes									
PDFH	5	0.02 (0.02)		0.03 (0.06)		0.03 (0.04)			
Lepisosteidae – gars									
LNGR	15	0.05 (0.05)			0.02 (0.04)	0.07 (0.10)	0.04 (0.08)	0.17 (0.17)	
SNGR	24	0.08 (0.06)	0.13 (0.25)	0.03 (0.06)		0.12 (0.12)	0.08 (0.17)	0.22 (0.34)	
Hiodontidae – mooneyes									
GDEY	253	0.95 (0.48)	2.75 (3.33)	2.28 (1.64)	1.33 (1.90)	0.25 (0.15)	0.25 (0.36)	0.72 (0.78)	
Clupeidae – herrings									
GZSD	6	0.02 (0.02)			0.04 (0.08)	0.02 (0.03)		0.06 (0.11)	
Cyprinidae – carps and minnows									
GSCP	1	< 0.01 (0.01)					0.04 (0.08)		

CARP	11	0.04 (0.03)	0.13 (0.25)	0.03 (0.06)		0.03 (0.04)		0.11 (0.15)
SVCP	2	0.01 (0.01)			0.02 (0.04)	0.01 (0.02)		
BHCP	1	< 0.01 (0.01)			0.02 (0.04)			
Catostomidae – suckers								
RVCP	6	0.02 (0.02)	0.25 (0.50)	0.03 (0.06)		0.01 (0.02)		0.06 (0.11)
WTSK	1	< 0.01 (0.01)		0.03 (0.06)				
BUSK*	150	0.51 (0.16)	0.25 (0.50)	0.58 (0.38)	0.38 (0.25)	0.64 (0.32)	0.38 (0.39)	0.94 (0.99)
SMBF	6	0.02 (0.02)				0.04 (0.04)		0.06 (0.11)
SHRH	5	0.02 (0.01)		0.08 (0.09)			0.04 (0.08)	0.06 (0.11)
BMBF*	1	< 0.01 (0.01)						
Ictaluridae – bullhead catfishes								
BLCF	4	0.01 (0.02)		0.06 (0.11)		0.02 (0.02)		
CNCF	15	0.05 (0.03)		0.03 (0.06)		0.08 (0.05)		0.06 (0.11)
Percidae – perches								
SGER*	32	0.11 (0.04)	0.25 (0.29)	0.14 (0.18)	0.06 (0.09)	0.10 (0.06)	0.04 (0.08)	0.39 (0.36)
WLEY	6	0.02 (0.02)		0.03 (0.06)		0.03 (0.04)		0.06 (0.11)
Sciaenidae – drums								
FWDM	2	0.01 (0.01)		0.03 (0.06)		0.01 (0.02)		

Appendix E. (gillnet CPUE - extended).

Species					
	SCCL			CONF	
Macro- Meso-	POOL	CHNB	ITIP	POOL	CHNB
Ascipenseridae - sturgeons					
PDSG*	0.17 (0.33)		N-E		
SNSG*	13.92 (23.96)	9.50 (18.34)	N-E	14.25 (16.73)	6.25 (2.18)
Lepisosteidae – gars					
STGR			N-E		
LNGR		0.25 (0.50)	N-E		
SNGR	0.08 (0.17)		N-E		
Hiodontidae – mooneyes					
GDEY	1.50 (1.00)	5.25 (9.13)	N-E	0.38 (0.75)	
Cyprinidae – carps and minnows					
CARP	0.17 (0.33)		N-E	0.25 (0.29)	
Catostomidae – suckers					
RVCP	0.08 (0.17)		N-E		
BUSK*			N-E	0.63 (0.48)	
BMBF*			N-E	0.13 (0.25)	

CNCF	Ictaluridae – bullhead catfishes	N-E	0.38 (0.75)
SGER*	Percidae – perches	N-E	0.13 (0.25)

N-E: non-existent habitat in Segment 9.
W: wild habitat for this particular gear.

Appendix F. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by mesohabitat within a macrohabitat for all species caught with otter-trawl during the sturgeon season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB		SCCS	ISB			TRML
Macro-Meso-			CHNB	POOL	CHNB	CHNB	POOL	TLWG	CHNB
SNSG*	85	0.79 (0.28)	1.40 (2.00)	W	0.68 (1.36)	0.47 (0.22)	1.04 (0.00)	W	1.33 (2.04)
PDFH	1	0.01 (0.02)		W				W	
GDEY	1	0.01 (0.02)		W				W	
GZSD	1	0.01 (0.02)		W				W	
Cyprinidae – carps and minnows									
RDSN	5	0.04 (0.05)		W	0.34 (0.68)	0.04 (0.07)		W	
CARP	10	0.09 (0.13)		W	0.34 (0.68)	0.01 (0.02)		W	
SKCB*	69	0.68 (0.28)	0.74 (1.48)	W	1.36 (2.72)	0.71 (0.37)		W	
SGCB*	4	0.03 (0.03)		W		0.05 (0.06)		W	
SFCB*	16	0.14 (0.09)		W	1.02 (2.04)	0.16 (0.13)		W	

SVCB	45	0.32 (0.15)		W	0.34 (0.68)	0.23 (0.16)	2.08 (0.00)	W	1.11 (1.35)
ERSN	95	0.44 (0.67)		W	0.34 (0.68)	0.60 (1.15)		W	0.56 (1.11)
RVSN	3	0.03 (0.05)		W	1.02 (2.04)			W	
Catostomidae – suckers									
RVCP	8	0.07 (0.07)		W		0.09 (0.11)		W	
BUSK*	6	0.05 (0.04)		W		0.08 (0.07)		W	
Ictaluridae – bullhead catfishes									
CNCF	328	3.45 (1.49)	5.89 (9.75)	W	5.44 (10.88)	3.37 (1.87)	39.58 (0.00)	W	1.15 (0.20)
STCT	2	0.03 (0.04)		W		0.04 (0.06)		W	
FHCF	4	0.04 (0.04)	0.37 (0.74)	W		0.05 (0.06)		W	
Sciaenidae – drums									
FWDM	9	0.11 (0.08)	1.09 (1.28)	W		0.06 (0.07)	1.04 (0.00)	W	

Appendix F. (otter-trawl CPUE - extended).

Species										
Macro- Meso-	CHXO			SCCL				CONF		
	CHNB	POOL	TLWG	POOL	CHNB	TLWG	ITIP	POOL	CHNB	TLWG
SNSG*	0.93 (0.51)	W	W	Ascipenseridae - sturgeons						
				W	3.71 (4.34)	W	N-E	W	0.70 (0.06)	W
PDFH	0.04 (0.07)	W	W	Polyodontidae – paddlefishes						
				W		W	N-E	W		W
GDEY	0.04 (0.07)	W	W	Hiodontidae – mooneyes						
				W		W	N-E	W		W
GZSD	0.03 (0.06)	W	W	Clupeidae – herrings						
				W		W	N-E	W		W
RDSN	0.04 (0.08)	W	W	Cyprinidae – carps and minnows						
				W		W	N-E	W		W
CARP	0.30 (0.52)	W	W	W		W	N-E	W		W
SKCB*	0.70 (0.65)	W	W	W	0.78 (0.09)	W	N-E	W		W
SFCB*	0.07 (0.10)	W	W	W		W	N-E	W		W
SVCB	0.41 (0.33)	W	W	W	0.29 (0.58)	W	N-E	W	0.18 (0.36)	W
ERSN	0.23 (0.27)	W	W	W		W	N-E	W		W

Catostomidae – suckers									
RVCP	0.07 (0.10)	W	W	W	W	N-E	W		W
BUSK*	0.03 (0.07)	W	W	W	W	N-E	W		W
Ictaluridae – bullhead catfishes									
CNCF	2.17 (1.01)	W	W	W	1.51 (0.75)	W	N-E	W	0.50 (1.00)
Sciaenidae – drums									
FWDM	0.09 (0.12)	W	W	W	W	N-E	W		W

N-E: non-existent habitat in Segment 9.
W: wild habitat for this particular gear.

Appendix G. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by mesohabitat within a macrohabitat for all species caught with trammel nets during the sturgeon season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB			ISB			TRML
Macro-Meso-			CHNB	POOL	TLWG	CHNB	POOL	TLWG	CHNB
PDSG*	1	0.02 (0.03)		W	W		W	W	
SNSG*	221	1.94 (1.01)		W	W	1.20 (0.51)	W	W	
LNGR	1	0.01 (0.03)		W	W	0.02 (0.04)	W	W	
SNGR	2	0.02 (0.03)		W	W	0.02 (0.03)	W	W	
GDEY	23	0.28 (0.14)		W	W	0.24 (0.18)	W	W	
GZSD	6	0.08 (0.08)		W	W	0.10 (0.11)	W	W	
GSCP	6	0.06 (0.06)		W	W	0.08 (0.08)	W	W	
CARP	4	0.05 (0.05)		W	W	0.04 (0.06)	W	W	
BHCP	1	0.01 (0.02)		W	W		W	W	

			Catostomidae – suckers				
BUSK*	21	0.25 (0.13)	W	W	0.20 (0.12)	W	W
SMBF	5	0.05 (0.04)	W	W	0.02 (0.04)	W	W
BMBF*	2	0.02 (0.03)	W	W		W	W
			Ictaluridae – bullhead catfishes				
BLCF	1	< 0.01 (0.01)	W	W	0.01 (0.01)	W	W
CNCF	6	0.06 (0.05)	W	W	0.07 (0.06)	W	W
FHCF	1	0.01 (0.03)	W	W	0.02 (0.04)	W	W
			Percichthyidae – temperate basses				
WTBS	1	0.01 (0.02)	W	W		W	W
			Percidae – perches				
SGER*	1	< 0.01 (0.01)	W	W		W	W
WLEY	1	0.01 (0.02)	W	W		W	W
			Sciaenidae – drums				
FWDM	1	0.01 (0.02)	W	W	0.01 (0.03)	W	W

Appendix G. (trammel net CPUE - extended).

Species										
Macro-	CHXO			SCCL				CONF		
Meso-	CHNB	POOL	TLWG	POOL	CHNB	TLWG	ITIP	POOL	CHNB	TLWG
Ascipenseridae - sturgeons										
PDSG*	0.07 (0.13)	W	W	W		W	N-E	W		W
SNSG*	0.93 (0.55)	W	W	W	21.56 (6.87)	W	N-E	W	13.17 (24.33)	W
Lepisosteidae – gars										
SNGR		W	W	W	0.31 (0.63)	W	N-E	W		W
Hiodontidae – mooneyes										
GDEY	0.42 (0.28)	W	W	W	0.31 (0.63)	W	N-E	W		W
Clupeidae – herrings										
GZSD	0.04 (0.08)	W	W	W		W	N-E	W		W
Cyprinidae – carps and minnows										
GSCP	0.04 (0.08)	W	W	W		W	N-E	W		W
CARP	0.10 (0.14)	W	W	W		W	N-E	W		W
BHCP	0.05 (0.09)	W	W	W		W	N-E	W		W
Catostomidae – suckers										
BUSK*	0.37 (0.41)	W	W	W	0.31 (0.63)	W	N-E	W	0.33 (0.00)	W
SMBF	0.08 (0.12)	W	W	W	0.31 (0.63)	W	N-E	W	0.17 (0.33)	W

BMBF*	0.10 (0.14)	W	W	W	W	N-E	W		W
				Ictaluridae – bullhead catfishes					
CNCF	0.04 (0.08)	W	W	W	W	N-E	W	0.17 (0.33)	W
				Percichthyidae – temperate basses					
WTBS	0.04 (0.08)	W	W	W	W	N-E	W		W
				Percidae – perches					
WLEY	0.05 (0.09)	W	W	W	W	N-E	W		W
SGER		W	W	W	W	N-E	W	0.17 (0.33)	W

N-E: non-existent habitat in Segment 9.
W: wild habitat for this particular gear.

Appendix H. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by mesohabitat within a macrohabitat for all species caught with otter trawls during the fish community season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Total CPUE	OSB			ISB			TRML
Macro- Meso-			CHNB	POOL	TLWG	CHNB	POOL	TLWG	CHNB
Ascipenseridae - sturgeons									
PDSG*	2	0.01 (0.02)		W	W	0.02 (0.03)	W	W	
SNSG*	139	1.03 (0.34)	2.07 (4.14)	W	W	0.90 (0.43)	W	W	1.00 (2.00)
Polyodontidae – paddlefishes									
PDFH	1	0.01 (0.02)		W	W		W	W	
Hiodontidae – mooneyes									
GDEY	1	0.01 (0.01)		W	W	0.01 (0.20)	W	W	
Cyprinidae – carps and minnows									
RDSN	4	0.05 (0.08)		W	W	0.08 (0.13)	W	W	
CARP	3	0.02 (0.03)		W	W		W	W	
SKCB*	140	1.13 (0.72)		W	W	1.20 (1.03)	W	W	0.17 (0.33)
SGCB*	17	0.12 (0.10)		W	W	0.12 (0.14)	W	W	
SFCB*	13	0.08 (0.06)		W	W	0.09 (0.09)	W	W	0.17 (0.33)
SVCB	156	1.38 (1.24)		W	W	1.74 (1.90)	W	W	0.17 (0.33)

ERSN	10	0.10 (0.12)	W	W	0.15 (0.18)	W	W	
RVSN	6	0.05 (0.06)	W	W	0.04 (0.06)	W	W	
SNSN*	2	0.01 (0.01)	W	W		W	W	0.33 (0.67)
Catostomidae – suckers								
RVCP	2	0.01 (0.02)	W	W	0.02 (0.03)	W	W	
BUSK*	20	0.16 (0.10)	W	W	0.20 (0.14)	W	W	
Ictaluridae – bullhead catfishes								
BLCF	60	0.53 (0.42)	W	W	0.63 (0.59)	W	W	
CNCF	403	3.45 (1.55)	W	W	3.07 (1.52)	W	W	0.50 (0.33)
STCT	2	0.02 (0.03)	W	W		W	W	
FHCF	4	0.03 (0.03)	W	W		W	W	
Atherinidae – silversides								
BKSS	1	0.01 (0.01)	W	W	0.01 (0.02)	W	W	
Percichthyidae – temperate basses								
WTBS	2	0.02 (0.03)	W	W	0.03 (0.04)	W	W	
Percidae – perches								
SGER*	1	< 0.01 (0.01)	W	W		W	W	0.17 (0.33)
Sciaenidae – drums								
FWDM	114	0.87 (1.02)	W	W	0.31 (0.25)	W	W	

Appendix H. (otter trawl CPUE - extended).

Species										
Macro- Meso-	CHXO			SCCL				CONF		
	CHNB	POOL	TLWG	POOL	CHNB	TLWG	ITIP	POOL	CHNB	TLWG
SNSG*	1.05 (0.62)	W	W	Ascipenseridae - sturgeons				W	2.33 (2.00)	W
				W	1.75 (2.03)	W	N-E			
PDFH	0.04 (0.09)	W	W	Polyodontidae – paddlefishes				W		W
				W		W	N-E			
CARP	0.08 (0.12)	W	W	Cyprinidae – carps and minnows				W	0.17 (0.33)	W
				W		W	N-E			
SKCB*	1.17 (1.14)	W	W	W	1.23 (1.99)	W	N-E	W	0.17 (0.33)	W
SGCB*	0.04 (0.08)	W	W	W	0.80 (0.93)	W	N-E	W		W
SFCB*	0.10 (0.11)	W	W	W		W	N-E	W		W
SVCB	0.84 (0.78)	W	W	W	0.35 (0.40)	W	N-E	W	0.33 (0.67)	W
RVSN	0.10 (0.20)	W	W	W		W	N-E	W		W
BUSK*	0.09 (0.13)	W	W	Catostomidae – suckers				W	0.67 (1.33)	W
				W		W	N-E			
BLCF	0.04 (0.09)	W	W	Ictaluridae – bullhead catfishes				W		W
				W	2.64 (4.40)	W	N-E			
CNCF	4.59 (4.74)	W	W	W	7.09 (5.09)	W	N-E	W	0.67 (1.33)	W

STCT	0.08 (0.11)	W	W	W		W	N-E	W	W
FHCF	0.07 (0.10)	W	W	W	0.26 (0.34)	W	N-E	W	W
Sciaenidae – drums									
FWDM	0.70 (0.83)	W	W	W	11.97 (23.94)	W	N-E	W	W

N-E: non-existent habitat in Segment 9.

W: wild habitat for this particular gear.

Appendix I. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by mesohabitat within a macrohabitat for all species caught with trammel nets during the fish community season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB			ISB			TRML
Macro- Meso-			CHNB	POOL	TLWG	CHNB	POOL	TLWG	CHNB
			Ascipenseridae - sturgeons						
PDSG*	1	0.01 (0.02)		W	W	0.02 (0.03)	W	W	
SNSG*	369	3.54 (1.89)		W	W	3.03 (2.21)	W	W	
			Lepisosteidae – gars						
LNGR	4	0.04 (0.04)		W	W	0.05 (0.05)	W	W	
SNGR	1	0.01 (0.02)		W	W	0.02 (0.03)	W	W	
			Hiodontidae – mooneyes						
GDEY	12	0.12 (0.08)		W	W	0.12 (0.09)	W	W	
			Cyprinidae – carps and minnows						
GSCP	4	0.04 (0.04)		W	W	0.02 (0.03)	W	W	
CARP	5	0.06 (0.07)		W	W	0.05 (0.08)	W	W	
BHCP	11	0.06 (0.08)		W	W		W	W	
			Catostomidae – suckers						
RVCP	4	0.04 (0.04)		W	W	0.05 (0.06)	W	W	

BUSK*	88	0.86 (0.33)	W	W	0.94 (0.42)	W	W
SMBF	5	0.04 (0.03)	W	W	0.03 (0.04)	W	W
BMBF*	1	0.01 (0.03)	W	W		W	W
Ictaluridae – bullhead catfishes							
CNCF	11	0.12 (0.08)	W	W	0.13 (0.11)	W	W
Sciaenidae – drums							
FWDM	1	0.01 (0.03)	W	W	0.02 (0.04)	W	W

Appendix I. (trammel net CPUE - extended).

Species										
Macro- Meso-	CHXO			SCCL				CONF		
	CHNB	POOL	TLWG	POOL	CHNB	TLWG	ITIP	POOL	CHNB	TLWG
Ascipenseridae - sturgeons										
PDSG*		W	W	W		W	N-E	W		W
SNSG*	1.53 (0.91)	W	W	W	20.76 (15.56)	W	N-E	W	0.69 (0.61)	W
Lepisosteidae – gars										
LNGR	0.05 (0.10)	W	W	W		W	N-E	W		W
SNGR		W	W	W		W		W		W
				W		W		W		W
Hiodontidae – mooneyes										
GDEY	0.16 (0.23)	W	W			W	N-E	W		W
Cyprinidae – carps and minnows										
GSCP	0.11 (0.15)	W	W	W		W	N-E	W		W
CARP	0.10 (0.14)	W	W	W		W	N-E	W		W
BHCP	0.05 (0.11)	W	W	W		W	N-E	W	2.33 (2.33)	W
Catostomidae – suckers										
RVCP		W	W	W		W	N-E	W		W
BUSK*	0.48 (0.61)	W	W	W	1.88 (1.34)	W	N-E	W		W
SMBF	0.04 (0.08)	W	W	W		W	N-E	W	0.25 (0.50)	W
BMBF*	0.06 (0.11)	W	W	W		W	N-E	W		W

Ictaluridae – bullhead catfishes									
CNCF	0.11 (0.15)	W	W	W	0.18 (0.37)	W	N-E	W	W

N-E: non-existent habitat in Segment 9.
W: wild habitat for this particular gear.

Appendix J. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/m²) by mesohabitat within a macrohabitat for all species caught with bag seines during the fish community season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB BAR	ISB BAR	CHXO BAR	SCCL BAR	SCCS BAR	SCN BAR	TRML BAR	TRMS BAR	CONF BAR
Clupeidae - herrings											
GZSD	383	5.75 (4.49)	4.54 (7.79)	4.00 (2.20)	3.00 (2.09)	89.70 (166.35)		N-E	0.92 (1.83)		1.15 (2.30)
Cyprinidae – carps and minnows											
RDSN	201	2.03 (0.77)	1.42 (0.87)	2.57 (1.26)	1.68 (1.21)	1.15 (0.67)		N-E			0.29 (0.58)
SFSN	30	0.23 (0.28)		0.17 (0.26)				N-E			5.59 (7.73)
CARP	1	0.02 (0.03)		0.03 (0.07)				N-E			
PNMW*	179	1.50 (0.88)	1.90 (1.72)	1.47 (0.88)	1.88 (2.65)			N-E			
SKCB*	2	0.02 (0.04)		0.05 (0.07)				N-E			
SGCB*	2	0.02 (0.03)		0.03 (0.07)				N-E			
SVCB	47	0.52 (0.21)	0.66 (0.79)	0.49 (0.25)	0.57 (0.50)	0.75 (1.49)		N-E			0.32 (0.63)
ERSN	442	5.03 (2.20)	1.44 (1.11)	7.80 (3.86)	2.27 (1.16)			N-E	0.73 (1.47)		
RVSN	208	2.12 (0.77)	0.09 (0.19)	2.67 (1.25)	2.16 (1.13)	0.82 (1.63)		N-E			0.63 (1.26)
BMSN	15	0.14 (0.12)	0.39 (0.79)	0.16 (0.16)	0.04 (0.08)			N-E			
SNSN*	33	0.34 (0.20)		0.27 (0.17)	0.66 (0.61)			N-E			0.63 (1.26)

FHMW	6	0.06 (0.06)	0.09 (0.19)	0.05 (0.08)	0.08 (0.12)	N-E	
FHCB	3	0.03 (0.04)		0.06 (0.07)		N-E	
Catostomidae - suckers							
RVCP	24	0.29 (0.19)		0.34 (0.30)	0.34 (0.37)	0.41 (0.82)	N-E
QLBK	24	0.28 (0.18)		0.22 (0.22)	0.56 (0.50)		N-E 0.25 (0.49)
SMBF	3	0.04 (0.05)			0.13 (0.19)		N-E
BMBF*	1	0.01 (0.02)		0.02 (0.03)			N-E
SHRH	2	0.02 (0.04)		0.03 (0.06)	0.03 (0.05)		N-E
Ictaluridae – bullhead catfishes							
CNCF	19	0.20 (0.12)	0.20 (0.39)	0.26 (0.19)	0.14 (0.21)		N-E 0.29 (0.58)
Percichthyidae – temperate basses							
WTBS	27	0.43 (0.20)	0.30 (0.42)	0.17 (0.12)	1.06 (0.58)	0.75 (1.49)	N-E
Centrarchidae - sunfishes							
GNSF	1	0.01 (0.03)		0.02 (0.05)			N-E
OSSF	35	0.56 (0.64)		0.69 (1.10)	0.71 (0.91)		N-E
BLGL	12	0.17 (0.14)	0.18 (0.36)	0.05 (0.07)	0.40 (0.43)	0.75 (1.49)	N-E
LMBS	1	0.02 (0.05)			0.08 (0.16)		N-E
BKCP	2	0.01 (0.03)		0.03 (0.05)			N-E
UCN	1	0.01 (0.03)			0.05 (0.11)		N-E
Percidae - perches							

YWPH	1	0.02 (0.04)			0.08 (0.15)		N-E	
						Sciaenidae - drums		
FWDM	34	0.41 (0.30)	0.18 (0.36)	0.26 (0.28)	0.52 (0.68)	4.13 (6.64)	N-E	0.32 (0.63)

N-E: non-existent habitat in Segment 9.

Appendix K. Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/net-night) by mesohabitat within a macrohabitat for all species caught with mini-fyke nets during the fish community season for segment 9 of the channelized Missouri River during 2004. Species captured are listed phylogenetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B.

Species	Total catch	Overall CPUE	OSB BAR	ISB BAR	CHXO BAR	SCCL BAR	SCCS BAR	SCN BAR	TRML BAR	TRMS BAR	CONF BAR
					Lepisosteidae – gars						
SNGR	9	0.11 (0.10)	0.09 (0.18)	0.15 (0.18)	0.09 (0.13)	1.00 (2.00)		N-E	0.50 (1.00)		
					Hiodontidae - mooneyes						
GDEY	1	0.01 (0.03)		0.02 (0.05)				N-E			
					Clupeidae - herrings						
GZSD	17	0.22 (0.16)	0.36 (0.73)	0.10 (0.10)	0.27 (0.38)			N-E			
					Cyprinidae – carps and minnows						
RDSN	229	2.90 (1.42)	1.73 (2.06)	3.56 (2.49)	2.59 (1.84)	3.00 (0.00)		N-E	0.50 (1.00)		
SFSN	25	0.32 (0.22)	0.27 (0.55)	0.17 (0.26)	0.55 (0.55)	0.50 (1.00)		N-E	0.50 (1.00)		1.00 (-)
CARP	1	0.01 (0.03)		0.02 (0.05)				N-E			
PNMW*	43	0.54 (0.41)	1.00 (1.62)	0.32 (0.33)	0.64 (1.01)			N-E	2.50 (5.00)		
SKCB*	23	0.29 (0.24)		0.44 (0.42)	0.23 (0.37)			N-E			
SVCB	39	0.49 (0.19)	0.09 (0.18)	0.59 (0.26)	0.50 (0.41)	1.00 (2.00)		N-E	0.50 (1.00)		

ERSN	645	8.16 (4.32)	1.55 (1.95)	13.37 (7.91)	3.45 (2.31)	1.00 (2.00)	N-E	1.00 (0.00)	
RVSN	266	3.37 (1.60)	2.36 (3.35)	4.07 (2.76)	2.86 (1.94)	1.50 (3.00)	N-E	3.50 (7.00)	
SNSN*	119	1.51 (1.02)	0.45 (0.73)	1.49 (1.24)	1.95 (2.79)	1.50 (3.00)	N-E	3.50 (7.00)	
FHMW	17	0.22 (0.18)	0.09 (0.18)	0.32 (0.34)	0.14 (0.15)		N-E		
UCY	69	0.87 (1.05)		0.17 (0.26)	1.91 (3.29)		N-E	10.00 (20.00)	
Catostomidae - suckers									
RVCP	8	0.10 (0.09)	0.09 (0.18)	0.05 (0.10)	0.23 (0.26)		N-E		
QLBK	2	0.03 (0.04)		0.02 (0.05)	0.05 (0.09)		N-E		
UCS	2	0.03 (0.05)			0.09 (0.18)		N-E		
SMBF	1	0.01 (0.03)	0.09 (0.18)				N-E		
Ictaluridae – bullhead catfishes									
BLCF	1	0.01 (0.03)		0.02 (0.05)			N-E		
CNCF	82	1.04 (0.37)	1.64 (1.95)	0.71 (0.27)	1.09 (0.62)	3.50 (5.00)	N-E	1.00 (0.00)	2.00 (-)
FHCF	1	0.01 (0.03)	0.09 (0.18)				N-E		
Poeciliidae - livebearers									
MQTF	2	0.03 (0.04)	0.09 (0.18)	0.02 (0.05)			N-E		
Atherinidae - silversides									
BKSS	1	0.01 (0.03)			0.05 (0.09)		N-E		
Percichthyidae – temperate basses									
WTBS	6	0.08 (0.07)	0.09 (0.18)	0.07 (0.08)			N-E		2.00 (-)

Centrarchidae - sunfishes						
GNSF	23	0.29 (0.17)	0.27 (0.55)	0.34 (0.23)	0.27 (0.33)	N-E
OSSF	40	0.51 (0.31)	0.45 (0.42)	0.39 (0.40)	0.64 (0.72)	N-E
BLGL	74	0.94 (0.48)	1.00 (1.81)	1.00 (0.58)	0.86 (1.04)	N-E
ULP	5	0.06 (0.13)		0.12 (0.24)		N-E
LMBS	1	0.01 (0.03)	0.09 (0.18)			N-E
WTCP	1	0.01 (0.03)			0.50 (1.00)	N-E
UCN	16	0.20 (0.22)	0.73 (1.27)	0.02 (0.05)	0.18 (0.36)	N-E
					1.50 (3.00)	
Sciaenidae - drums						
FWDM	1	0.44 (0.22)	0.45 (0.56)	0.34 (0.18)	0.32 (0.20)	N-E
					4.50 (5.00)	

N-E: non-existent habitat in Segment 9.